THE

ELECTRICAL REVIEW.

VOL. LXXIV. MARCH 27, 1914. No. 1,896.

ELECTRICAL REVIEW.

Vol. LXXIV.] CONTENTS: March 27, 1914. [No. 1,896.

	Page
Road Transport	517
Co-operative Electric Ownership	518
Copper	519
The Electric Vehicle	519
The Government and Monopoly Problems in Germany	520
Correspondence—	
Reversing an Interpole Motor	521
Nitrates from Peat	521
Protection or Tyranny?	521
The Lighting of the I.E.E. Lecture Theatre	522
A Motor Problem	522
The "Cascade" Induction Motor	522
A Two-Rate Tariff System without Time Operated Control	523
New Electrical Devices, Fittings and Plant (*illus.*)	524
Legal	526
The Mackay Companies	527
Load, Strength, Stress and Strain	528
Business Notes	528
Notes	535
The Late Mr. George Westinghouse (*illus.*)	537
The 2,400-volt Direct-Current Electrification of the Butte, Anaconda and Pacific Railway, U.S.A. (*illus.*)	538
Electrical Power Applications in the Construction of the County Hall, Westminster (*illus.*)	540
City Notes	543
Stocks and Shares	548
Share List of Electrical Companies	549
Trade Statistics of India	551
Reviews	552
Notes from Canada	553
Reliability of Supply and the Maintenance of Plant, by L. Marshall Jockel	554
The Gulstad Vibrating Relay, by W. Judd (*illus.*)	556
The Electrical Trades Benevolent Institution	556
Electric Battery Vehicles (*illus.*)	557
The Shanghai Electric Supply Proposal	559
New Patents Applied For, 1914	560
Abstracts of Published Specifications	560
Contractors' Column	Advertisement pages xxiv and xxvi

THE ELECTRICAL REVIEW.

Published every FRIDAY, Price 4d.

The Oldest Weekly Electrical Paper. Established 1872.

TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY.

OFFICE:—4, LUDGATE HILL, LONDON, E.C.

Telegraphic Address: "AGEEKAY, LONDON." Code, A B C.

Telephone Nos.: Holborn 933; Central 4425 (Editorial only).

The "Electrical Review" is the recognised medium of the Electrical Trades, and has by far the Largest Circulation of any Electrical Industrial Paper in Great Britain.

Subscription Rates.—Per annum, postage inclusive, in Great Britain, 19s. 6d.; Canada, £1 1s. 8d. ($5.30). To all other countries, £1 10s.

FOREIGN AGENTS:

ADELAIDE: Messrs. Atkinson & Co., Gresham Street.
AUCKLAND, N.Z.: Gordon & Gotch, Albert Street; The Mining and Engineering Review, 31A, Strand Arcade, Queen Street.
BERLIN: Asher & Co., Unter den Linden; Speyer & Peters, Unter den Linden 43, N.W. 7.
BRISBANE: Gordon & Gotch, Queen St.
CHRISTCHURCH, N.Z.: Gordon and Gotch, Manchester Street.
DUNEDIN, N.Z.: Gordon & Gotch, Princes Street.
JOHANNESBURG, CAPETOWN, BLOEMFONTEIN, DURBAN, PORT ELIZABETH, &c.: Central News Agency, Ltd.
LAUNCESTON: Gordon & Gotch, Cimitiere Street.
MELBOURNE: The Mining & Engineering Review, 90, William Street; Gordon & Gotch, Queen Street.
MILAN: Fratelli Treves.
NEW YORK: D. Van Nostrand, 25, Park Place.
PARIS: Boyveau & Chevillet, 22, Rue de la Banque.
PERTH, W.A.: Gordon & Gotch, William Street.
ROME: Loescher & Co., Corso Umberto I° 307.
SYDNEY: The Mining & Engineering Review, 273, George Street; Gordon and Gotch, Pitt Street.
TORONTO, ONT.: Wm. Dawson & Sons, Ltd., Manning Chambers; Gordon and Gotch, 132, Bay Street.
WELLINGTON, N.Z. Gordon & Gotch, Cuba Street.

Cheques and Postal Orders (on Chief Office, London) to be made payable to THE ELECTRICAL REVIEW, and crossed "London City and Midland Bank, Newgate Street Branch."

THE UNIVERSAL ELECTRICAL DIRECTORY

(J. A. Berly's).

1914 EDITION

NOW READY.

H. Alabaster, Gatehouse & Co., 4, Ludgate Hill, London, E.C.

ROAD TRANSPORT.

ONE of the most important subjects on the electrical table at the moment is undoubtedly that of road transport and the conditions under which it is carried on. The three chief factors in this business, so far as we are concerned, are the tramcar, the independent motor-'bus, and the railless trolley 'bus; to these in the not distant future may be added the electric battery omnibus, but we need not take it into consideration at the moment. These three types of vehicle make use of the public roads, in common with the great mass of private pleasure and commercial vehicles, and those belonging to the Government or local authorities; and the use of the roads in common is the crux of the problem which must be faced and solved.

The roads must be maintained in good and serviceable condition, by someone—at present, the local county and borough authorities; who shall bear the cost of their upkeep? The roads, no doubt, were made and are maintained for the public benefit, and so far as their use is merely incidental to the affairs of the various users, it appears just and reasonable that the cost should be borne by public funds; such funds are best administered by the local governing bodies, and provided that the local community makes the greatest use of the roads, the funds should equitably be derived from local sources. Modern motor traffic, however, extends far beyond the confines of the districts within which it originates, and in many cases roads have to be maintained by a locality through which they pass, mainly for the benefit of users who contribute nothing to the local exchequer. Such cases can fairly be met by taxation of motor vehicles capable of travelling for long distances and grants by the central government to the localities concerned.

But the three classes of transport vehicle that we have mentioned above come under an entirely different category. Their range is restricted within quite definite bounds, and, moreover, their use of the roads is not merely incidental to their business—it is essential to it, the fundamental reason for their existence. These vehicles use the roads as part of their plant or stock-in-trade, for the purpose of performing a public service and reaping a corresponding profit. Clearly, therefore, all these vehicular undertakings ought to contribute to the upkeep of the roads in proportion to their user. The same applies, of course, to all vehicles which ply for hire, and to public carriers who convey goods or passengers by road from place to place.

Confining our attention to the three classes, what is the present situation? The tramways pay rates upon the track and bear the cost of maintaining not only their track—which is worn by other vehicles besides their own—but also the pavement between and alongside of the rails, from which they derive no benefit whatever. Now that horse traction is obsolete, they are physically unable to use the pavement, which they therefore maintain wholly for the benefit of the public—and of their competitors.

The motor-omnibuses pay a tax on petrol to the central government, but when they do not use petrol they are, of course, exempt from this tax. The funds raised in this way, however, are not applied at all to the maintenance of the roads which the 'buses use, or even of necessity to the locality in which the 'buses ply. Moreover, the tax is a light one compared with the burden unjustly laid upon the successors of the horse tramways. The trolley omnibus is subject to the payment of rates upon the overhead equip-

ment, and it escapes the petrol tax. It has been usual, however, for Parliament to lay a charge upon it for road maintenance amounting to about $\frac{3}{8}$d. per 'bus-mile, which represents a contribution of something like £100 per annum per 'bus per mile of road, with a fairly frequent service.

The inference from this comparison is obvious. We have drawn attention to the gross injustice obtaining under the present system on previous occasions, but that is no reason why we should relax our efforts to secure reform in this matter. We have not here referred to the additional burden imposed upon tramway authorities in the shape of the obligation to carry workmen at fares which cannot possibly be made remunerative, a system which, in plain words, constitutes a subsidy to the working class, and through them to their employers, who are thereby enabled to obtain their services more cheaply. Probably this evil is past mending, in view of the political exigencies of municipal control. Dealing only with the road maintenance question, therefore, we repeat that the tramcar and the railless trolley 'bus are most unfairly handicapped by statutory burdens in their competition with the independent motor-'bus, which in point of fact, owing to its great weight, does twice as much damage to the road surface as the trolley 'bus, breaks down the foundations of the roads, and cynically wears out the pavements which the tramway altruistically repairs—under compulsion.

Moreover, while the tramways and trolley 'buses are in most cases operated by public authorities, the motor-'buses are usually in private ownership, so that the latter really are subsidised by the public purse. We have no prejudice against private enterprise—quite the contrary—but we cannot regard this state of affairs as salutary or beneficial to the community.

We note with pleasure that strong representations have recently been made to the Chancellor of the Exchequer on this subject by Mr. T. B. Goodyer, the energetic manager of the Croydon Corporation tramways and the hon. secretary of the Metropolitan Association of Electric Tramway Managers, who points out that of the 10 municipal authorities operating tramways in the metropolitan area, with a capital of over 14 millions sterling invested in their undertakings, no fewer than eight last year made deficits aggregating nearly £20,000, and only two showed a surplus after paying capital charges—namely, the London County Council (with a capital of over 12 millions), £497, and the Croydon Corporation, £10,586. The latter, we may point out, had not during the year been seriously affected by 'bus competition, but this happy state no longer prevails. The same 10 authorities expended £186,697 on repairs to the tracks, and paid rates and taxes to the amount of £146,000 on their tracks and buildings. Still worse results are foreshadowed for the current year, and Mr. Goodyer emphasises the need for "such legislation as will place motor-omnibus operators on terms of equality with the municipal tramways authorities in the metropolitan area, with regard to the public burdens the latter now have to bear." A Governmental Committee has for some time been considering the subject of local taxation, and the moment is timely for the utmost efforts to be made to secure impartial and exhaustive consideration of the situation of the tramways and motor-omnibuses.

We cordially endorse the statements of Mr. Goodyer, and wish him success in his praiseworthy endeavours. How serious the matter is may be gathered from the fact that the L.C.C. not only failed to provide a due allocation to the reserve and renewals fund, but actually drew upon that fund to the amount of £37,334! So that, in point of fact, the Council's tramways made no profit but a heavy loss upon the year's working.

CO-OPERATIVE ELECTRIC OWNERSHIP.

Some months ago a good deal of attention was given in our pages to the question of co-operative municipal and company ownership and control of electric supply undertakings. The subject has been studied from the technical standpoint by engineers of broad and unbiased views, and from the general standpoint by men of affairs capable of impartially handling public questions. In the opinion of many observers in this and other countries, the policy of municipalisation of electrical facilities has so repeatedly revealed its limitations, that the time cannot be far off when there will be a widespread desire to vary it by procedure based upon combined or co-operative principles. According to a recent report, to which we have already fully referred, the tendency in that direction is very pronounced in Germany, and at the root of all proposals that have been made in this country in recent days concerning the great strides that electricity supply business should make in the coming years, there lies the same conviction that the giving of the amplest possible facilities should not be hindered by the restrictions inherent to municipalisation. To our minds it is inevitable for the matter to be very much under discussion here in the near future.

But the problem is not one merely for England or for Germany. We have before us now a series of reports that have been prepared at Shanghai, in which the same question is closely studied in relation to the very successful electrical undertaking that has been in operation there as a publicly-owned concern for 21 years. Some ten months ago the municipal Council appointed a special Committee to report in reply to four questions. One of these asked whether a further immediate extension of the plant was necessary or desirable, and the reporters had no difficulty in replying that whatever else happened this was imperatively necessary in order to keep pace with the ever-increasing demand, and that two 5,000-kw. turbo-alternators would meet the case. The other questions were :—Does the connection of the electrical undertaking with the Council adversely affect either the Council's credit or financial facilities, or the prosperity and development of the undertaking, or is there any probability of its doing so in the future? If these questions were answered in the affirmative, the Committee were to say "what steps are desirable with a view to counteracting the effect."

It appears that the total loan which has been issued in respect of the electricity department has actually exceeded the general municipal loan, and while the department is in an eminently sound and satisfactory position, and is an advantage to the credit of the Council on that account, "there can be no doubt that the necessary extensive borrowings for the account of the department tend to fetter the issue of municipal loans for general purposes, and that this tendency is likely to be emphasised in the future." "The marketability of municipal debentures is to some extent prejudiced by the fact that no provision is being made for the redemption of those which pertain to the department." The electrical undertaking is indisputably prosperous, and its present position is largely due to its connection with the Council, "but the balance-sheet and prospects at present indicate that the department is now better financially fitted to stand by itself." Further, the activities of the department have been lessened by objections to wiring and sale of fittings and to municipal trading in general. As the growth of the business continues, it is believed that the effect of these hampering restrictions will grow too.

Though these answers to the questions are not completely in the affirmative, the committee considered it desirable to investigate whether alternative management would be advantageous, and while a unanimous opinion is given that a department of such value to the community should "not be handed over to outside concessionaires or financiers under any circumstances," the suggestion is made that the "ratepayers, through their representatives, the Council, might float and register a company for working the undertaking, retaining such sufficient number of shares therein as would ensure control of the management by the Council." It is believed that a reasonable dividend on such holding of shares would provide a very much larger sum in relief of rates than is at present contributed by the department. As the result of an exhaustive consideration, a number of proposals to this end are advanced. These we reprint on another page. The estimated contribution from the electricity department to municipal income during 1914 is Tls. 30,255 without any provision made for the repayment of the Electricity Loans, but on the assumption

that the Council would receive a dividend of 8 per cent. from the proposed company, there would be an income of Tls. 280,000, and after deduction of interest and redemption there would be a balance of Tls. 82,500 per annum for transfer to municipal income. The Committee's recommendation, which, we believe, was to come before a ratepayers' meeting held on Friday last, was based largely upon financial considerations, but they add: "Their proposal would carry with it the additional advantage of relieving the members of Council of a considerable part of their present multifarious responsibilities."

It will be interesting to learn the attitude of the Shanghai public toward such a proposal, but whether they have given their approval or not, the full ventilation of the subject can only do good. The discussion of such a question in many a centre in the British Isles would have the effect of bringing the public more closely into touch with electrical questions, in which they are less interested than they should be. At present too often it is thought that if a man advances what are described as anti-municipal views, he is interested in some ulterior way in advancing the interests of private parties; but we believe it will be found that among those behind the scenes in municipal life there exist convictions, based upon knowledge and experience of practical working, that what has been proposed at Shanghai should also be considered in England.

Copper.

There has lately been a decided improvement in the demand from consumers of copper, but to a large extent the development of activity in this direction has been at the expense of prices, for producers, unable to market their product at the ruling rates, set about reducing them to a level which would prove attractive, the result being a drop in prices to not far short of £66 a ton for electro. Round this figure some business was attracted, and with an improving sentiment in the general market, prices then took an upward course, and at the moment the position seems to have cleared up a little, and a more confident tone prevails. While there are certainly conditions which are actually pretty favourable for copper, there are yet a number of points of weakness which cannot be disregarded. On the strong side it must be conceded that, as far as can be ascertained, there is a considerable excess even yet of consumption over supply.

The European statistics continue to be uniformly favourable to holders of copper, and after the deplorably bad American figures issued for the month of December, there has been a steady improvement across the Atlantic. On the other hand, there is a strong suspicion that the European statistics do not actually portray the position. It is argued that the consumption has really undergone a reduction in Europe, and it is pointed out that in face of this the deliveries have increased.

For this state of things there are two explanations put forward, one that consumers have let their stocks run down to starvation point, and are now engaged in putting a little on their shelves, and the other that there is a process of secret storing going on in Europe. There have been some rather persistent rumours to this effect in circulation for several weeks, and efforts have been made by leading parties to run them down to something definite and concrete, but without effect. On the whole, it seems probable that consumers have been taking copper into their yards with greater liberality than before, on the assumption that the metal was really cheap round its present price, and, acting upon this theory, they have a good deal in their favour, for copper at £65 is really not dear, though it has on many occasions been cheaper. In 1907, for instance, it stood at £55 10s., in 1908 at £56 2s. 6d., in 1909 at £54 10s., in 1910 at £52 15s., in 1911 at £53 7s. 6d., and in 1912 was at one time below £61 for cash standard, so that there would not be anything phenomenal in the price again dropping to something like that seen in some of the recent years, should demands not keep pace with production. On the other hand, the cost of production has become greater, and, indeed, is said to have been permanently increased as regards labour charges, while the increasing depth of mines adds to the cost of winning the ore, and in many cases the ores recovered are leaner in yield.

On the whole, it is probable that the older mines are more costly to run now than they were five years ago, and this may make some difference, but too much stress should not be laid on this aspect of the copper situation. Certainly the world's resources should be fully ample to meet the comparatively reduced demand for the metal likely to be met with during a period of trade reaction, and probably if things get worse, and prices fall further, the time will come when the more costly mines will restrict their production. This has been the way in which relief has been found on previous occasions, and there is no reason why the same should not be seen again.

According to reports to hand from Germany, the electrical trades there are beginning to feel the need of new orders. Already some of the largest firms in the industry find that new work is reaching them with much less force than has been the case for many months past, and some difficulty is reported in finding employment for plants. Under these circumstances the statements met with that certain of the larger German copper consumers are forced to ask for the postponement of deliveries seems to receive confirmation.

So far as Great Britain is concerned, however, there is still a fair amount of orders to be dealt with, and given a resumption of political confidence and a mitigation of the financial unsettlement on the Continent and in South America, matters should improve moderately.

The Electric Vehicle.

Last week's discussion on the electric vehicle before the I.E.E., despite the lengthy list of speakers, cannot be said to have added greatly to the sum total of our knowledge of this subject, although indicative of the interest which has been aroused.

We are, of course, still practically dependent on the operating data of our American and Continental friends, and this, although sufficiently satisfying to the average engineer, is not nearly so convincing to the potential user in this country as facts and figures obtained from British sources and the possibility of seeing the vehicles in actual use.

The pressing need, which Mr. Beauchamp emphasised, is to get the vehicles on the road in convincing numbers, and this is, as he pointed out, a commercial and financial problem. He suggested the feasibility of contract haulage schemes, with this end in view, which reminds us that we have ourselves repeatedly urged the necessity of evolving hire and hire-purchase schemes, with a view to overcoming the difficulty which first cost must present to many potential users.

Another speaker touched on the congested state of the London streets, and the peculiar fitness of the electric vehicle to replace the slow-moving horse-drawn traffic which is mostly held responsible for this condition of things. Where power-driven vehicles form any considerable percentage of crowded traffic, the horse is obviously out-of-date. Every form of power vehicle in London at the present time is more or less penalised, and compelled to operate inefficiently, in order that the horse may retain a place in the streets, and unless it is speedily eliminated the ratepayers will also be mulcted to provide wider roads for its accommodation.

An obvious remedy for this state of affairs, and one which would bring to a head the question of the most suitable type of power-driven vehicle for our streets, would be the enforcement of higher speed requirements on all the present slow-moving vehicles on our streets. We prosecute a man for exceeding the legal speed limit on a lonely country road, but the sluggard can hold up the traffic in a crowded street with impunity. In this connection a factor which is likely to be of great importance where many types of vehicle operate on the same road, is speed regulation, and no vehicle provides such a complete speed range as the electric; furthermore, it is the only vehicle which does not waste fuel when held up by traffic, and given some form of automatic controller, it will be ideal for the unskilled driver.

THE GOVERNMENT AND MONOPOLY PROBLEMS IN GERMANY.

The question of the adoption by the Government of measures to counteract the monopolistic tendency in the German electrical industry in the matter of the supply of plant and materials and the execution of installation work, has just been raised in the Lower House of the Prussian Diet. In reply, Herr Sydow, Minister of Commerce, stated that the increasing use of electrical energy had led to efforts in the direction of concentration, and to the accumulation, in the case of the great undertakings, of powerful forces, which had an immense influence on the economic life of the country. The Minister admitted that under the existing legal situation nothing could be done to cope with the tendency, and he added that new means must be provided for the purpose, either by the introduction of an obligation to obtain Government concessions or in some other way. This statement is peculiar when applied to the supply of plant and materials, and the carrying out of installation work in contradistinction to the generation and distribution of energy from electricity works, but the basis of the success of the great firms in the former respect is very largely founded upon the monopolistic movements which have taken place and are still proceeding in the latter direction, which the Minister is understood to have also had in mind when replying to the interrogation brought forward by members.

It is only the monopoly in the supply of current through subsidiary undertakings—which the great electrical firms have endeavoured to obtain from the beginning, and which they have partly secured without detriment to many efforts put forth by municipal authorities to gain and maintain their independence—that has afforded them the possibility of getting a greater and increasing measure of control over contracts for the delivery of plant and materials and installation work, and of diverting this business from the manufacturing firms of lesser importance and the contractors. Certain it is that the three or four great firms do not dominate the construction of machinery and apparatus to such an extent that they can be said to possess a monopoly in these manufacturing departments, as numerous other firms exist in almost all branches—the special electrical firms as they are generally termed—and these are claimed to be equally as efficient as the great firms. The reason for the predominance of the latter lies in the fact that they hold an almost uninterrupted monopoly in the construction and equipment of electricity works, overland central stations, railways, and tramways, &c., and the initial stages of this development extend back to the commencement of the supply business many years ago. At that time the municipal and other local authorities were unable to decide at first upon the establishment of electricity works on their own account as the latter seemed to involve too complicated problems for local government, and at the same time threatened to open up competition with the gas works owned by the local authorities.

It was under these circumstances that the private firms felt compelled to proceed with the erection of electricity works at their own financial risk and thus create a consuming public, and the system of amalgamation and participation in subsidiary companies was a direct result of this enterprising and profitable policy of the great firms. The advantages devolving upon the latter from the combination of manufacturing, construction, and installation work were, and still are to a large extent, that the electricity works and tramways which they were interested in financing became fixed or definite customers who were in a certain measure not accessible to competitive firms.

On the other hand, the disadvantages to these particular customers were that, being dependent upon the manufacturing firms, they were unable to purchase their plant and materials in the cheapest market, and were consequently compelled to pay prices over which they could exercise no control whatever. In addition, the firms associated with these supply works obtained possession of the installation contracts at prices which, temporarily at all events, prevented any possibility of outside competition being successful, whilst the withdrawal of rivalry subsequently enabled recoupment to be secured by the introduction of higher prices for further work.

It is well known, as has been mentioned in former issues of this journal, that efforts have been put forth both by municipal or communal authorities and by the Federal Governments, to place a check on these disadvantages of the growing private monopoly. The Governments of Prussia, Saxony, Baden, and Wurtemberg, for instance, have at various times in the past few years instructed their provincial and district representatives to pay attention, in the grant of concessions for electricity works, to the circumstance that equality of conditions should be observed between the contracting manufacturers, and the special works and installation contractors. The orders issued to this effect have probably been given legal effect, but in fact the great firms still remain at an advantage. As they erected the works, they were more familiar with the machinery and plant and the requirements in general, and as they were earlier informed than the outside firms, they were also able to work up the installation business all the sooner, and thus further extend their scope. The counteracting measures have, consequently, been of very little avail. Not only so, but the municipalisation of electricity works is now proceeding at a slower rate than formerly, owing to the disadvantages arising from the growth of communal bureaucracy, labour troubles, the difficulty of raising loans for purposes other than those for absolutely indispensable works, and technical considerations. The latter observation applies to the possible expansion of supply works beyond the limits of the town or commune concerned, and this has led to the manifestation of the desire for the combination of various districts in one single supply system. As a result, the form of "mixed undertakings" has been selected in a number of cases, private enterprise co-operating with municipal authorities in the establishment of a company in which both parties are financially interested and have representatives on the board. It has, however, been found in many cases that the control of these undertakings has not been more efficacious than in the case of a municipal system. In view of the present interest in the subject in England and Shanghai, this circumstance should be noted.

If now the Minister of Public Works has referred to the possible introduction of compulsory State concessions for electricity works—assuming that his observations really applied to supply works and not merely to plant and materials and installation work — he probably proceeded from the standpoint that combined private and municipal undertakings require to be supplemented by the creation of a higher concession authority, meaning the State, for the adequate preservation of the public interests. This point of view may seem plausible from a theoretical standpoint—but the *Berliner Tageblatt* states that it is defective on a practical basis, as it would establish a higher authority both for private supply companies and the local authorities, and thus place the latter still further under the guardianship of the State, and interfere with their freedom of local government. For these reasons it is contended that serious doubts arise against the introduction of State concessions; especially as such a system would guarantee no absolute remedy for existing conditions, and would produce dangers which, under certain circumstances, would be not less detrimental than the disadvantages which are to be removed by it. The legislative interference with the freedom of activity, it is held, would only have as its object the nationalisation of the generating systems, leaving the distribution to the companies and the local authorities. The price would be regulated in a more uniform manner and be lower than at present on the concentration of production in a few large modern works.

The introduction of a State monopoly of production in Germany is a question which, in the opinion of the Berlin newspaper, requires further discussion from the standpoint of proceeding by Imperial or Federal State legislation, and in this connection it has to be remembered that the most important water-powers are situated in the South, although Federal agreements with private companies could be better dealt with by Imperial than by independent Federal action. It is, however, well not to underestimate the difficulties which would beset a State monopoly. The latter would have to come to an agreement with the owners of

many old stations or take over these at a price at which they could not be advantageously used under the suggested new conditions. This question and other problems require a fundamental statistical investigation, which the newspaper states ought to be begun without delay. In any case, the principle of a current production monopoly is held to be more sensible than a petroleum monopoly, as the former would regulate the output of energy produced and consumed in the country itself, and would hold out the prospect, it is submitted, of a cheaper supply to consumers in general, whereas the supply of petroleum is mainly dependent upon deliveries from other countries.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Reversing an Interpole Motor.

In reversing a shunt interpole motor, the armature and interpole coils should be regarded as one winding, and may be connected up to the reversing drum of a barrel-type controller. A change of rotation in a motor of this type may be brought about by changing over the shunt leads, but this is an objectionable practice and should be avoided.

When reversing a compound interpole machine, the armature and interpole coils should, as in the former case, be regarded as one winding, but in this case the polarity of the load coils on the main poles must be left unchanged in order to retain the cumulative effect of the shunt and series windings.

A common characteristic of a shunt interpole motor is a tendency to "hunt" on the occurrence of an overload, and in this connection it may be interesting to quote a case which recently came under my notice.

A liberally-rated 15-B.H.P. shunt interpole machine by a well-known maker operated quite satisfactorily under its rated full load, but immediately upon the occurrence of a 10 per cent. overload to which it was occasionally subjected would commence to "hunt" badly, the station ammeter showing a perfectly regular "beat" from 10 to 100 amperes (the working current was 70 amperes).

The maximum speed attained during this period of hunting was such as to endanger the gear of the drive, and until the motor was replaced with a new and larger machine it was found necessary to alter the lead of the brushes each time it was reversed. The neutral position of the brushes would not allow the machine to take anything over its normal full load without this hunting being set up.

I should much like to read the experience of others upon this subject.

H. C. Widlake.

Plymouth, *March 17th*, 1914.

Nitrates from Peat.

On December 19th, 1913, there appeared in your columns an article by Georges Dary on "The Production of Nitrates by the Direct Electrolysis of Peat Deposits."

Being engaged at the present time in making a thorough investigation into the various methods which are employed for the production of nitrates and other fertilisers by electrical means, this article was of special interest to me, and I had hoped that it would draw forth some discussion.

Since the manufacture of nitrates by means of the fixation of atmospheric nitrogen by the well-known Birkeland-Eyde and Schönherr processes, and the production of calcium cyanamide by the Franke-Caro method, are taking place on such a large scale, it is evident that the market for these products is very large. Any new process promising to compete with the existing ones is, therefore, of considerable interest.

Mr. Dary, in his article, gives a rosy view of the profits which could be obtained from a large installation working on the system described.

Unless my information and conclusions are all wrong, however, I find it impossible to agree with him, and shall be very glad if he can prove the correctness of his statements in view of the following :—

The article refers to the electrolytic extraction of *100,000 tons* of nitrates *per annum* from a peat deposit of *370 acres* (italics are mine).

Assuming such a deposit to have an average depth of 6½ ft., which is a fair figure to take, and is used elsewhere by the author of the article, and taking the nitrogen content at 2 per cent., it seems to be a fairly simple calculation to work out to show that the *maximum possible* production of nitrates (assuming $CaNO_3$ to be intended) which could be made from such a bog would be 48,100 tons. This, too, is the theoretical figure, which would certainly be impossible of attainment in practice. At the rate at which Mr. Dary proposes to produce nitrates, the whole bog would therefore be completely exhausted in less than six months.

Again, in speaking of the energy required "under the best conditions of efficiency of output" (to quote the article), it is stated that about 950 lb. of nitric acid per hectare (= 385 lb. per acre) can be produced per 24 hours; for 370 acres this equals about 23,200 tons in one year, assuming the process to be in continuous operation the whole time.

The weight of nitrogen contained in 23,200 tons of nitric acid would be about 22 per cent. of this, or, say, 5,100 tons, which would suffice for the manufacture of some 36,500 tons of $CaNO_3$; yet Mr. Dary speaks of the production of 100,000 tons in the same period, viz., one year, from such a bog. How can the production of the smaller quantity be said to be "under the best conditions of efficiency of output," if it be possible to extract it at three times the rate, and still make the handsome net profit of £707,500 per annum? Does the author mean that at the lower rate a still higher profit could be made, and is he thus giving the readers of the REVIEW a conservative estimate? Still another point may be criticised, but this must be the last, although there are several others, such as the loose phraseology employed (notably where electrical matters are dealt with), and the reference to nitric acid as "$NH_2 O_3$."

The article says that "a deposit of peat, having a depth of 6½ ft. and an average richness in nitrogen of 2 per cent., can produce between 800 and 900 tons of pure nitrates per year." Puzzle : Find the area of the bog !

It would seem that British investors ready to put any money into a scheme for developing this process, which, we are told, "has recently been patented in the United Kingdom," would be well advised to look a little closer into it before parting with their capital, and that electrical engineers who are fortunate enough to have a station located in the vicinity of a peat bog, and are considering the nice profit which could be made in off-peak hours, might very well follow their example.

Alfred S. L. Barnes.

Toronto, Canada, *March 11th*, 1914.

Protection or Tyranny?

I am gratified to find that the chairman of the council of the B.E.A.M.A. has honoured me with his attention, for whatever reason—but I certainly am curious to know why my pen-name should give me any claim to his consideration. It is gratifying, too, to have an explicit statement that no such rule exists—by which, I take it to be meant that no such *formulated* rule exists—and to have the chairman's wider denial, though I feel that, if confusion of diction implies confusion of thought, the mental processes of a writer who can use words implying the knowledge of a *latent* desire in others, are certainly in need of checking.

But a wide question still demands attention. Rightly or wrongly, large numbers of all grades of workers are deeply dissatisfied with the workings of the B.E.A.M.A. Mr. Fletcher's letter and very pertinent question should show the Association that I am very far from being alone in voicing these feelings, though it may be that these other workers, like myself, "stupidly misjudge"—to quote the chairman's courteous phrase—the Association's policy.

If the Association will seriously inquire into the reasons for these grave discontents, and will do its utmost to remove

D

them, it will earn the gratitude of all workers in the electrical trades, and will truly accomplish much towards guiding "a sorely-tried industry into paths of prosperity."

Junius.

[Another letter appears in our "Notes" pages.—Eds. Elec. Rev.]

The Lighting of the I.E.E. Lecture Theatre.

In reply to your invitation for observations on the lighting of the lecture theatre of the Institution of Electrical Engineers, I think that the opinion which you expressed more than three years ago, that the lighting was "highly effective," and "a typical application of modern scientific methods," is one with which many members cannot agree. It was novel and interesting, and is carried out in a pleasing manner, but the general opinion seems to be that the effect is dull and depressing.

The illumination was good. I have not any recent information, but Mr. J. S. Dow informs me that measurements made by him and Mr. V. H. Mackinney gave the illumination as 2 ft.-candles, about one-quarter of which was due to the mercury arcs. This is more than double the illumination in the old theatre of the Institution of Civil Engineers when I measured it in 1892.

The reason for the monotonous appearance seems to be that we are accustomed, in cases of brilliant and cheerful lighting, to see the lamps or their shades, that is, points or patches of considerable brightness. If these are absent, cheerfulness cannot be produced unless strong illumination is used.

The lecture theatre at the Institution of Civil Engineers is lighted on exactly the same principle; the illumination is practically the same, but the general effect is much better, because the cove is far brighter, and there is no mahogany strip below it. In both cases the colour of the walls simply mops up light like a sponge, and the problem at the I.E.E. is rendered more difficult by reason of the large area of glass.

An invalid wearies of "slops," however nourishing, and longs for something to bite. I believe that a few lamps judiciously placed, and contributing but little to the illumination, would have the desired effect.

A. P. Trotter.

London, S.W., *March 21st*, 1914.

Your leaderette on the subject of the Institution lighting will be read with interest by all those who have been handicapped by the position you have hitherto taken up in the matter of shadowless lighting. Those of us who have had experience in factory lighting know that the shadowless method of lighting was tried at least 20 years ago, and found to be unsatisfactory. The original claim for it, when open type arc lamps and top reflectors were used, was that it was the nearest approach to daylight; and the fact that this fallacy was accepted as truth by many people is, perhaps, characteristic of the modern tendency of the great mass of the public to allow a few people to do the thinking for them. It requires very little consideration indeed to appreciate that natural daylight is very far from being shadowless. After the novelty of the thing had worn off, and the inefficiency of the system from a commercial point of view had been demonstrated, the users—I almost said "dupes"—realised its efficiency from the point of view of illumination, and the system died out.

Later on, the mercury-vapour lamp made its appearance, and for some purposes there is no doubt a field for it; but it would never have made even the little progress it has made in the direction of interior lighting but for the fact that a representative of the Electrical Review visited a certain office lighted by this means in October, 1907, and after a pleasant chat with a pretty typist, came back and wrote a glowing testimonial, which appeared in your issue of October 18th, 1907. This testimonial has since been worked for all it is worth, and one got very tired of having it thrown at us by clients who thought we were behind the times in not recommending mercury-vapour lamps in preference to more efficient and more appropriate methods of illumination.

There is a possibility that the designers of the installation for the Institution were influenced by your testimonial, and it serves you right that now, after describing the I.E.E. theatre installation as "highly effective" about three years ago, you now find you were mistaken, and have to admit that it is anything but effective.

It is, I think, the general impression among members that it is about the worst lighted public meeting room in existence, the effect being funereal and most depressing.

Those of us who have for years fought against the method of shadowless illumination are delighted to find that at last you have seen the error of your ways, and it is to be hoped that the kick you have now administered to it will be its deathblow. Shadowless lighting is a most unnatural light, and instead of being restful as is claimed by its advocates, is just the opposite, as there is no rest for the eyes at all, except by closing them or shading them in some way. What is wanted in the lecture theatre is light and shade, which can be obtained by obvious means.

Frank Broadbent.

London, E.C., *March 24th*, 1914.

[Our correspondent appears to hold us responsible for the lighting of the theatre, and implies that we have been strenuous supporters of shadowless illumination. The former was arranged under the supervision of Members of the Council, who, no doubt, acted according to their lights; as regards indirect illumination, it is very satisfactory in some cases, but when did we advocate "shadowless" illumination?

We would gladly have published Mr. Broadbent's views on the subject had he given them expression at any time during the period to which he refers. It is significant that both he and Mr. Trotter agree with us that the lighting *is now* unsatisfactory, but neither condemns it *as it was* three years ago; nor did anyone at that time find fault with it, so far as we are aware. We do not say that it was not good then, but that it is not good now.—Eds. Elec. Rev.]

A Motor Problem.

The horse-power exerted by a motor is proportional to its torque and to the speed at which that torque is exerted. The conditions required by "Perplexed" may be arrived at by two methods:—

1. A shunt motor having in its field circuit a resistance of such a value as to allow it to carry its maximum load of 15 H.P. at 400 R.P.M., but which, when cut out of circuit, permits the speed to drop to the required 325 R.P.M.

2. These conditions may be partially—if not wholly—attained by means of a reversed series winding on the main poles.

The method used is a question which concerns the makers, but "Perplexed" should have no difficulty in getting a machine to suit his particular requirements.

H. C. Widlake.

Plymouth, *March 17th*, 1914.

THE CASCADE INDUCTION MOTOR.

(*For abstract of paper read by* Mr. L. J. Hunt *before the* Institution of Electrical Engineers, *see* Electrical Review, *page* 378.)

Discussion at Manchester.

Dr. E. Rosenberg complimented the author on his work in developing one of the most fascinating problems of electrical machine design, viz., the superposition of currents in the same winding. The author's machine seemed very little more complicated than the ordinary induction motor, but it appeared difficult, even impossible, to use liquid control for these motors; also, they could not be wound for such high voltages as ordinary induction motors. There was no difficulty in winding ordinary motors of a few hundred horse-power for 3,000 or 6,000 volts, but it was questionable whether the cascade motor could be wound to suit these high voltages.

Mr. W. Cramp said it was well known that alternating current problems might frequently be simplified by substituting for the actual, an equivalent circuit made up of resistances and reactances, with variables to represent the variable factors in the original circuit. Such a plan might be pursued in the case of the cascade motor and resulted in presenting the problem in a simple manner. From his diagram he drew certain conclusions and compared them with the statements made by Mr. Hunt.

In order that the cascade motor might compare with the ordinary induction motor, it was clear that the resistances, reactances and admittances of the cascade pair must not exceed the corresponding values of the ordinary machine. It was in this direction that Mr. Hunt had been so successful, and the combined windings which he had developed had in this their chief importance. The statement made by the author to the effect that the cascade connection of motors was the same as cascade connection of transformers was seen to be untrue, for the frequency throughout both transformers was identical, but in the second motor it was lower than in the first. The fact that the first motor developed part of the mechanical power was another cause of difference in the analogy. Some five years ago certain machines were put into operation by the speaker, and he had figures to show the results obtained on test as compared with the ordinary slip-ring motors supplied by other firms :—

	Slip-ring type.	*Slip-ring type.*	*Cascade type.*
6-H.P. motor.			
Speed	480	1,420	500
Efficiency	80 %	82 %	83 %
Power factor	69 %	85 %	78 %
12-H.P. motor.			
Speed	570	570	500
Efficiency	82 %	85 %	83 %
Power factor	76 %	82 %	83 %

The prices were practically equal when switchgear was included, so that the superiority of the cascade motor for low speeds was very obvious. The author stated that there was no objection to the increased number of leads ; as long as the starting switch could be fixed on the motor, well and good, but if it must be mounted away from the motor, then the cost of the cables was a distinct objection. With series motors and proper resistances on cranes, very slow movement of the motor with light loads might be obtained, but what happened with the induction motor and the cascade motor was that when there was a large resistance in the rotor so as to get "inching" with heavy loads, the motor ran away if the load fell. However, the operation would be better with the cascade motor than with the ordinary induction motor. He asked Mr. Hunt whether it was not true that on this principle the La Cour converter could be made with its two windings on the rotor together, so that its two machines would be merged into one, and the stator would then become like the stator of the ordinary series-wound alternating-current commutator motor.

Mr. F. C. Aldous said the improvement in power factor of cascade motors due to rotor resistance was obtained at the expense of efficiency, and would be smaller for machines of greater output. A highly saturated cascade motor would, under certain conditions, actually take practically constant current at all loads up to full load. Whereas in the ordinary slip-ring motor the whole of the tooth flux, and the whole of the ampere wires in the slot, acted upon one another, in the cascade motor two fluxes existed in the tooth, and in effect two sets of ampere wires in the windings, and each flux acted upon one set of currents only. In this feature the cascade motor was analogous to a two-speed induction motor with two separate windings. In this case one complete winding was always idle, but the whole of the tooth was utilised with the active winding, in other words, no flux space was ever wasted. As a result of the superposed fluxes, the D^2L of the cascade motor would be greater than that of a normal induction motor of the same output and built under similar conditions. A further disadvantage was the small choice of speed, the possible speeds on 50 cycles being 500, 333 and 250, whereas, with the normal induction motor the speeds over the same range would be 500, 428, 375, 333, 300, 273 and 250 r.p.m. From a manufacturing point of view the small range of speeds might be an advantage, if the machine to be driven could always be adapted to one of the available speeds. A well-designed slip-ring motor gave a very even turning moment at low speeds, and it was doubtful if anything better was needed. The application of the two-speed cascade motor to the driving of winding engines was of great interest, and, if possible, should result in a considerable saving in power. The saving could never be quite as great as shown, since the cascade connection could never take the motor up to cascade speed, owing to the slip and to the fact that resistances were always in the circuit. A disadvantage was the high tapping voltage ; the control gear would also be complicated, and it was doubtful whether mining engineers would be prepared to sacrifice the simplicity of the slip-ring motor for a slight reduction in power consumption.

Mr. W. Bolton Shaw said there were a great many advantages in being able to run cascade motors at two speeds. One application not mentioned in the paper was the driving of large dock pumps. The advantage of getting rid of slip-rings in mining work was obvious, and if the speed of cascade motors could be increased considerably beyond the present 500 r.p.m. they should have a good field of application in the case of high-speed mining pumps.

The Author, in reply to Dr. Rosenberg, said that liquid controllers were practically standard practice in connection with cascade motors. They had been used with motors up to 2,200 volts, and no trouble had been experienced. Three or four resistances insulated from earth by means of porcelain were usually employed. Regarding voltage suitable for the windings, 3,300 volts was the maximum which had been used. In a great many instances, two-speed motors were required, and it was not necessary, unless it was required to work under cascade speed, to connect the resistances to the stator tappings at all. The starting of the motor was effected by means of a resistance connected to the rotor resistance in the ordinary way, and a tachometer was used. The motor having been brought up to cascade speed, the short-circuiting switch was closed, and the rotor resistance lever allowed to fall back to the off position, thereby enabling a switch to be used, and the difficulty of high-voltage insulation avoided. This did not apply in the case of winding engines, and on the score of simplicity it was quite likely to be found advisable to go back to two windings on the stator, leaving one winding on the rotor. In the case of a 3,000-volt machine, the increase in cost would be 20 per cent. to 25 per cent., and the efficiency of a large motor would be reduced from 93 per cent. to 91 per cent. Mr. Cramp had referred to two transformers in cascade not being equivalent; that was so, but the author referred rather to the similarity of the motors when standing. Mr. Cramp had referred to the question of combining the two machines of a La Cour converter into a single machine. Patents had been in existence covering this scheme for about eight years, but the opportunity had not arisen to investigate the problem. Mr. Aldous had referred to the effect of resistance losses on efficiency, but if the machine could be kept cool by reducing the amount of copper in the stator to one-half, and putting the equivalent in the rotor, the power factor would be considerably increased without affecting the efficiency. In comparing the cascade motors with the ordinary induction motors made by one of the largest manufacturers in the country, the cascade motor was on the average found to be 10 per cent. larger than the ordinary motor. Regarding the space required for the second flux, it was found in practice that the depth of iron was only required to be increased by about 20 per cent. or 25 per cent. The choice of speed was limited in this type of motor ; in fact, these motors were not intended to be suitable for all purposes, but for cases where slip-rings were objectionable, and where two or three speeds were required. The variation in torque was very much smaller in this machine than in one of ordinary construction. The machine had been found very serviceable for winding engines, the control being very satisfactory. Motors were being used successfully to drive large dock pumps. The application to high-speed pumps was a very different problem.

A TWO-RATE TARIFF SYSTEM WITHOUT TIME-OPERATED CONTROL.

(*For abstract of the paper read before the* Institution of Electrical Engineers *by* Mr. H. H. Perry, *see* Electrical Review, *Vol. 73, page* 821.)

Discussion at Manchester.

Mr. J. Frith said the first thing about a tariff was that it should be understandable by the consumer ; he should be able to predict what the supply was going to cost him. The next point was that the tariff should encourage the free use of electricity. It would be interesting to hear how consumers liked the author's system.

Mr. S. J. Watson said the maximum-demand system failed because it was not understandable by the consumer. In principle it was quite correct, but different classes of consumers could not understand why one should pay a higher rate than another. For general supplies for domestic and similar purposes some method whereby only one circuit inside the house and one meter were employed would be the simplest and the best that could be adopted. People knew that their town rates were based on the rateable value of their property, they knew the rent they had to pay, and they could see at once what their liability was if a standing charge was made, and a small price per unit charged at the quarter end.

Mr. E. M. Hollingsworth said the author put forward a very ingenious and simple device, but it had arrived rather too late. The general adoption of the contract system showed that engineers had been trying to get away from the two-rate system. In considering different tariffs, consumers asked not so much the price per unit, but what it was going to cost per quarter or per year. They had to get down to a price which would bring in the comparatively small consumer, and had to prove to him that they could give advantages over the power or light at present in use.

Mr. J. S. Peck said that the author showed an arrangement by which the greater the power load the greater the lighting load which could be obtained at the low rate. This seemed to him to be wrong in principle, for if it was desired to keep down the peak load, the arrangement should be reversed so that the greater the power load at any time the less the lighting load which could be taken at the same time and at the low rate. Regarding the construction of the instrument itself, he anticipated trouble due to burning at the contacts ; the switch in its present form would only be suitable for handling very small currents. If the loss on alternating current was 8 to 10 watts, the volt-amperes across the switch would be several times this on account of the poor power factor, so that the voltage drop would be very considerable.

Mr. H. T. Wilkinson said he found it a great mistake to talk to consumers in terms of units. In one case an engineer was trying to convince a consumer that 0·8d. per unit was the correct charge to pay ; he could not drive this home, so he told him that in some places 5d. or 6d. was charged. The consumer replied that he did not know what a unit was, but 5d. or 6d. seemed a lot to pay for it. He had charged some consumers at so much per loom per annum, and found this was readily understood and worked out satisfactorily, the price, of course, varying with the different looms.

Mr. W. Cramp said that with the apparatus described in the paper, the less a consumer used the less he paid ; if the consumer

used lights only, and those only for a short period, he received a distinct advantage. It meant that if this system were adopted, a bill would be received of the following character: For a few lights, a low rate; for more lights, a higher rate; and for lights plus power, a lower rate again. The rate for electricity should be put into a unit which consumers could understand, not an electrical unit. In the case of a flour mill, for instance, if they charged for electricity at so much per sack, the miller knew just what was meant. All one had to do was to find out how many units were required in the making of a sack of flour. He thought there would be trouble with this type of apparatus, with any self-induction in circuit.

Mr. Barlow asked the author if at the end of a quarter a check could be taken on the readings for the preceding quarter; if not, how was it possible to be in a position to enforce the charges, should the consumer dispute them?

Prof. E. W. Marchant had doubts as to how the working of the switch was to be checked. If the switch stuck, it seemed that there would be a very heavy charge on the high-rate meter, and he would like to know whether there were any devices on the switch which would take care of such a contingency.

Mr. H. H. Perry, in reply, said emphasis had been laid on the fact that whatever system was chosen, it should be understandable by the consumer. He was perfectly in agreement on this point, and if a flat-rate system could be fixed up, by all means let them have it, one meter would then register the double supply. The switch contacts were amply large enough to carry a supply of 25 amperes. The instrument would only have to carry a quarter of 25 amperes, and he thought there was not the least chance of any trouble. Mr. Peck had raised a point regarding the means described by which the customer was given the same rate for lighting as for heating. The greater the load taken for heating, the less the amount charged for his lighting. The switch had not actually been working in practice. The switch had been tried with large self-induction in circuit, and found to work very satisfactorily. If large radiators or heaters were going to be used, it invariably meant new circuits; it was one of their greatest troubles to persuade people to add to their existing circuits.

Discussion at Leeds.

Mr. T. Roles agreed that in the past heating and cooking apparatus had been untrustworthy. He thought, however, that supply authorities must take some part of the blame for that, inasmuch as until quite recently they had charged such prices for current for heating and cooking that there had been no demand for these purposes, and therefore it had not been a business proposition for manufacturers to go into the question very thoroughly. In Bradford the power load was so large that it was impossible to notice any difference in peaks through the heating and cooking load. He thought that the need which led to Mr. Perry's proposition was met in Bradford by the domestic service system there, which, he thought, was better than the two-rate system proposed by him. The evil of the author's system was that it did not take into account the load factor of the lighting installation. The system also failed in the respect that they could not set the meter to read at the particular time of the peak load. So far as cooking was concerned, he agreed with the author's statement that it was a *sine quâ non* that a hiring department must be inaugurated if it was to be made familiar and profitable, but with radiators at so low a price as they were at present, heating could get along fairly well without any hiring department.

Mr. Perry, replying to Mr. Roles, said the rateable value system was the easiest way to get over the trouble of complex charges, and probably in the course of a few years, if heating and cooking became a very big thing, as he expected they would, this system of charging for domestic use would become almost universal. But there was this disadvantage in it—that it directly encouraged the consumer to use a very high peak. It was in the direction of the cooking that they ought to increase their business enormously, because it was folly to pretend that they could give heat in a house any more economically than the gas people could.

Mr. Burnand said that there was such a large proportion of the time when the valuable station plant was standing practically idle, that any increased revenue was worth getting hold of, even if it was at a low rate. Any device which would conduce to increase of the revenue at the time of the day when otherwise it would not exist was worth experimenting with. The great objection to it was that the system tended to restrict the load many times when the restriction would not be of any use whatever to the supply authorities. Another ground of objection was the high charge as applied to the lighting. The improvement in lighting—especially incandescent lighting—was such that in a few years lighting would lose altogether its present relative value as a determining factor in the cost of electrical supply. In regard to the author's view that the diversity factor is large enough to allow the coincidence of double peaks to be ignored, he felt that a very great saving in outlay on plant could be effected if they could only get rid of the coinciding double peaks. The two-rate system recently developed by Messrs. Handcock & Dykes, which was controlled from the generating station, gave great advantages over any maximum-demand system.

Mr. Thackeray said that he thought the system at Bradford, whereby power users were allowed to have a certain portion of their lighting supply reckoned at the power rate, was a means of getting over the difficulty which Mr. Perry was trying to obviate. He gathered from the paper that by this system it was quite possible to run an ordinary house at the low rate all the time. Taking it all round, the surest way for electrical development was to have a flat rate right through and a cheaper rate.

Mr. Wilson Hartnell said it appeared to him that the system of charging described in the paper was not a very rational way of doing things. He knew many instances now in which people were charged at the same rate whether for lighting or power. What did it matter what the supply was used for, so far as the peak load was concerned? Whether they were large users or domestic users, the simplest and most satisfactory thing was the flat rate.

Mr. Perry, in reply, said that members had not quite realised that the paper was dealing chiefly with domestic consumers, and did not really relate to persons taking a great amount of power. That observation applied to all the criticism. The whole object of the paper was to encourage a load resulting from heating and cooking apparatus. He did not suppose that that had so much importance in the North as it had in the South. Lighting was an absolute necessity, whereas power was not so, and if they cut down the lighting charge to the same rate as the power charge, he was afraid it would spell bankruptcy. Messrs. Handcock & Dykes's method was particularly ingenious, but he very much questioned whether it was legal. He did not think Mr. Thackeray's suggestion that a consumer could, by this two-rate system of his, obtain the low rate charge on the normal number of lights in the house was well founded. The provision of a daytime load was the only way to bring down the cost of production.

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Hope's Fuse Arc Arrester.

Tubular fuses, when used in earthed iron cases, are open to one very serious objection—*i.e.*, the gases are driven out of the tubes with great force on a heavy overload, and not infrequently an arc to the case is set up, or the arc rebounds from the case and burns the contents of the box. With the object of overcoming this objection, Messrs. Parmiter, Hope & Sugden, of Hulme Electrical Works, Manchester, have introduced a new arc arrester, and have applied for letters patent thereon.

The arc arrester is a china receptacle which, when placed opposite to the ends of the tubular fuse, takes up practically the whole of the volatilised metal on the fuse being subjected to a short circuit, and prevents any danger of an arc being set up to the case. Fig. 1 shows a view of the standard form of arc arrester, and figs. 2 and 3 show the two parts, whilst figs. 4 and 5 show the same parts after a severe short circuit.

It will be noticed that the arc arrester has a "bell-mouthed" opening, that there are two rows of small holes in the piece shown

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.

Fuse Arc Arrester and Parts.

in fig. 2, whilst in the centre of fig. 3 there is a round knob. The two parts, figs. 2 and 3, screw together, and are made in two parts merely for cleaning purposes.

The arc arrester is fixed in position opposite the fuse ends, and the gases, when the fuse blows, are driven through the "bell-mouthed" opening, and impinge on the round knob above-mentioned. They are sprayed round the shaped interior, and are driven out of the lower row of small holes, whilst cool air is drawn in through the top row of holes. The gases are greatly cooled by coming in contact with the cool china knob, and practically the whole of the volatilised copper is retained in the arc arrester.

In order to test the real effectiveness of the arc arrester, two identical fuse boxes were compared, differing only in that one was fitted with arc arresters, fig. 6, and the other was a standard box (fig. 7). The fuses were wired for 100 amperes and connected in series directly across a 460-volt, 150-kw., d.c. motor generator, with the cases of the boxes in each case earthed, and practically no cable in circuit.

The box without arc arresters (see fig. 7) went to earth with considerable damage to the contacts and interior, whilst in the box fitted with arc arresters the asbestos lining was not even dis-

coloured. This test was carried out more than once, with the same results, and recently this was demonstrated before a number of leading engineers. The tests were carried out by the Manchester Corporation electricity department.

The principal use of the arc arrester is in connection with iron-cased distribution fuse-boxes, and a number of the firm's standard

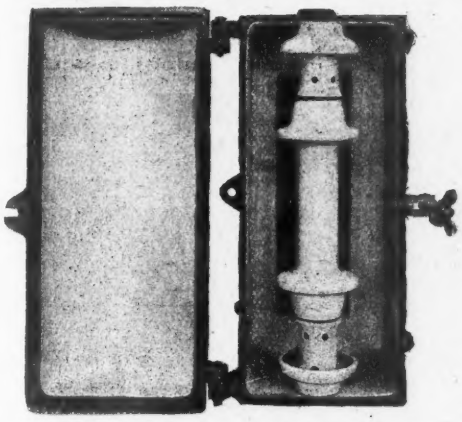


Fig. 6.—Fuse-Box Fitted with Arc Arresters; after Test.

forms of distribution board for three-phase work, fitted with arc arresters, have recently been supplied. It can also be used with great advantage for switchboard work. Valuable instruments, &c., have frequently been damaged by fuses blowing upon them. A

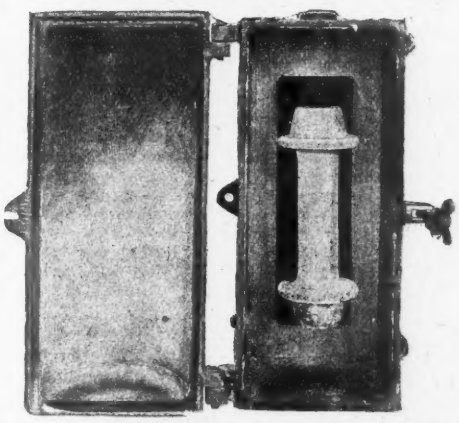


Fig. 7.—Standard Fuse-Box Used in Tests, showing Effects of Short-Circuit.

special adjustable form is made for switchboard use, to suit fuses of various distances from the base. The device can be used with almost any make of tubular fuse, and can generally be fitted to existing boxes of any make when the clearances allowed are sufficient. The china has a tapped hole in the centre of the back for fixing purposes, and the arc arrester can be fixed to the iron case, or the dividing fillets, by this means.

Some new "Semi-Indirect" Fittings.

The British Thomson-Houston Co., of Mazda House, Upper Thames Street, E.C., have recently introduced a new luminous bowl "Eye-Rest" fitting. It is an indirect fitting in which a small portion of the light (about 10 per cent.) is diffused through a translucent bowl, while the remaining 90 per cent. is reflected on to the ceiling by opaque X-ray reflectors. The bowl is formed of

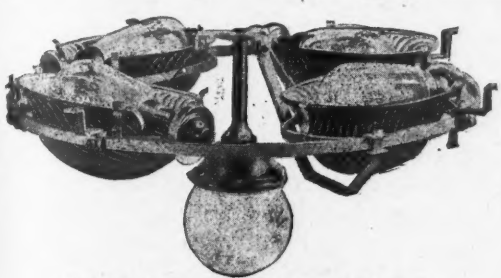


Fig. 8.—A New Semi-Indirect Fitting.

a delicately tinted glass dish, or of panels of tinted glass let into a composition framework. Below the X-ray reflector units is suspended a low-wattage Mazda lamp enclosed in an Alba glass ball. This lamp, which need not be larger than one-tenth of the total wattage, gives a soft uniform radiance to the translucent bowl. The luminous bowl is only for decorative effect, and does not in any way compete with the indirect illumination which proceeds from the ceiling.

The company has also designed a new form of "Eye-rest" unit, which, while possessing all the artistic and attractive features of the ordinary standard lamp, can, if required, be used for the

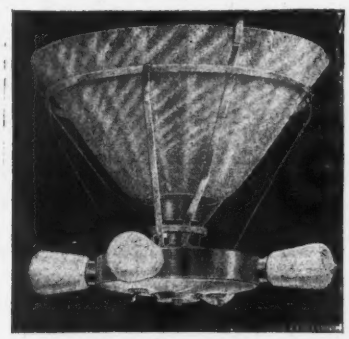


Fig. 9.—Semi-Indirect Fitting for Standard Lamp.

general illumination of the room. It has a single upturned X-ray silvered glass reflector concealed in the silk shade. The light is thrown on to the ceiling and reflected down into the room again, in the same way as with the suspended "Eye-rest" fittings.

In addition there are two or three low wattage Mazda lamps uniformly spaced around the pedestal underneath the X-ray reflector. These lamps can be used for the direct illumination of a table or desk.

Since the lamps are separately switched, it is possible to use the "Eye-rest" standard either as an indirect or a direct lighting unit, or as a combination of both.

New Portable Accumulator.

The Naylor Battery Co., Ltd., of Lammermoor Road, Balham, have designed and obtained protection for a new electrode for storage batteries, to meet the increasing application of these to motor-car starters, and to the lighting of cars, omnibuses and railway trains. A distinctive feature of the new plate is the fact that it is hollow, the electrolyte being able to circulate through the interior of the plate. It might appear that this would not be

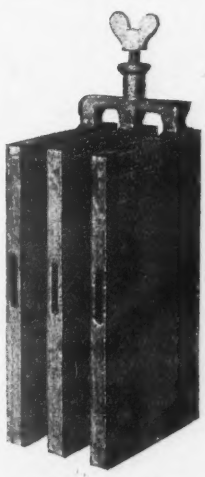


Fig. 10.—Naylor Battery Plate.

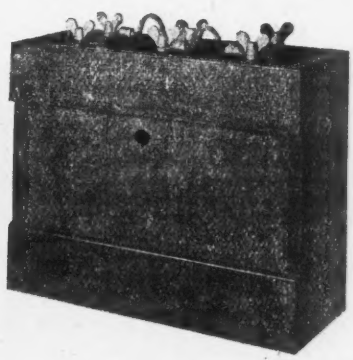


Fig. 11.—Naylor 6-Volt Battery.

effective in adding to the capacity of the plate, but in practice, we are informed, a very material gain is obtained; a plate $\frac{7}{16}$ in. thick × 4 in. wide × 7 in. high has a capacity of 35 ampere-hours, and is able to stand heavy charges and discharges. The plates are very strongly built, and have withstood for months without injury the jolting, vibration and overcharging experienced in omnibus lighting service.

Fig. 10 shows the three-plate positive, and fig. 11 a 6-volt set of 100 ampere-hours capacity. The train lighting cell weighs 33 lb. complete with electrolyte in an ebonite box, or 42 lb. in a wooden lead-lined box; when discharged at the rate of 20 amperes, it takes nearly six hours for the voltage to fall to 2 volts, or 10 hours to fall to 1·8 volts. Subject to only one condition, the company undertake to replace the plates of any cells they supply, when worn out, at a discount of 40 per cent. off the original price. They have had a ½-ton electric vehicle in constant use for 16 months, and find that the cost per battery-mile works out at less than 1d. They have supplied a large number of batteries to electric

carriage companies—77 to one company so far—under a new system of maintenance, and find that the type preferred for 38-cwt. landaulettes, carrying four passengers and driver, and capable of running 50 miles on one charge, with an average consumption of 40 amperes on the level, is a 200-A.H. cell, having an output of 12 watt-hours per lb. of cell complete when discharged at a rate of 50 amperes.

The Lavigne Electric Lock.

An ingenious unpickable electric lock has been developed by M. Eugène Lavigne, and is being placed on the English market by Messrs. Veritys, Ltd., and the Sun Electrical Co., Ltd. The arrangement is such that, while no signal is given when the door is opened by legitimate means, it is impossible to pick the lock, or, indeed, to begin to tamper with it in any way, without immediately sounding an alarm. The mechanical arrangement of

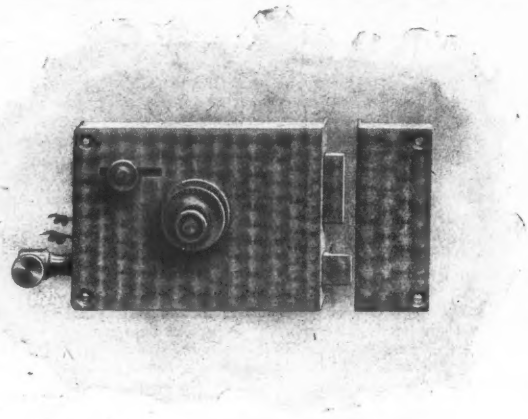


Fig. 12.—Lavigne Electric Lock.

the lock itself is such as to render it exceedingly difficult to open it except with the proper key, as the slightest pressure on the central pin closes an electric circuit; keys made of non-conducting material act like metal keys in this respect. The alarm can be set to ring when the door is opened from the outside, but not when it is opened from the inside; at night, however, it can be set to ring in both cases; the latch can similarly be made to give the alarm. The circuit is completed by way of the hinges, so that there are no visible wires to cut.

The lock is adaptable for use with or without knobs, and with or without spring latches; various patterns are available, for private houses, banks, outhouses, shop doors, &c. We illustrate in

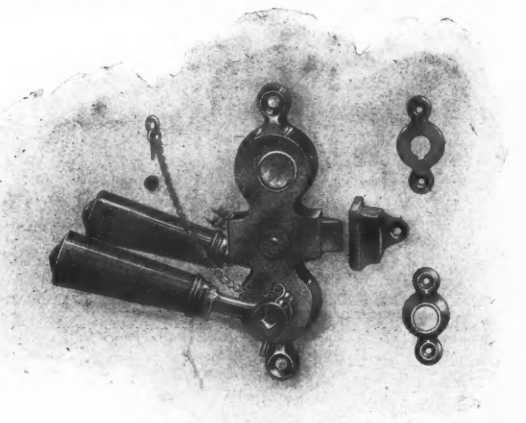


Fig. 13.—Electric Handle and Lock for Shop Door.

fig. 12, a lock suitable for houses and offices; fig. 13 shows a shop door handle and lock, for use with a key. The locks are made of steel or copper, very handsomely finished, and are of very substantial construction. Further particulars can be obtained from the above-named firms, or from M. Lavigne at the Ivanhoe Hotel, W.C.

Electric Vacuum Cleaner.

The British Vacuum Cleaner Co., Ltd., of Parson's Green Lane, S.W., are now building a new model F.F. cabinet type electric vacuum cleaner. It measures only 11 in. × 9 in. × 7 in., and weighs only 11 lb., with a full range of cleaning implements.

The power unit consists of a ⅛-H.P. motor, with a fan at each end of the spindle. One fan creates a volume of air necessary for domestic cleaning, with a certain amount of vacuum, and the other fan practically doubles the amount of vacuum obtained with the first fan. Both fans are connected to one inlet, and it is claimed that the amount of vacuum obtained is nearly twice as much as is shown by the bulk of fan machines of about the same price. All dust passing into the machine is intercepted in a dust bag before reaching the fans.

Half-Watt Lamp Fitting.

The Wardle Engineering Co., Ltd., of 196, Deansgate, Manchester, have brought out a fitting for a half-watt lamp, fitted

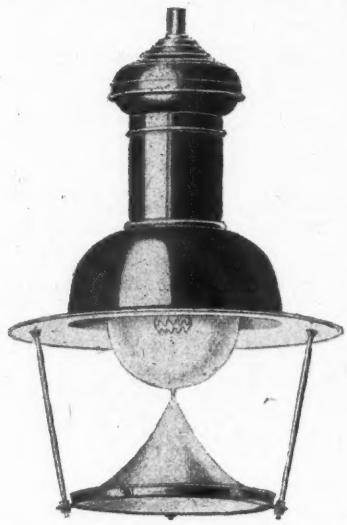


Fig. 14.—Half-watt Lamp Fitting with External Reflector.

with an external reflector, which adequately protects it from the weather. We are informed that this fitting has developed 5,000 c.p. at 20° from the horizontal, when used with a half-watt lamp rated at 3,000 c.p.

LEGAL.

Western Electric Co., Ltd., *v.* The Great Eastern Railway Co.

Transit of Electrical Goods.

In the Court of Appeal, on the 19th inst., Lord Sumner, Lord Justice Kennedy and Mr. Justice Lawrence had before them this case, on the appeal of the defendants against a decision of a Divisional Court (Justices Channell and Coleridge) affirming a judgment of the City of London Court (see Electrical Review, February 21st, 1913). The action was brought to recover damages in respect of injury to certain electrical goods of the plaintiffs, which were carried by the defendants by steamer and railway from Antwerp to North Woolwich *via* Harwich. The injury to the goods was found by the judge to be due to the fact that they were wetted by rain on the railway journey from Harwich to Woolwich owing to the neglect of the defendants' servants. By the terms of the contract and the bill of lading, the goods were to be carried at a reduced rate at owners' risk. In respect of the sea transit there was a bill of lading which contained a clause exempting the defendants from liability for damage arising, *inter alia*, from the negligence of the crew. The document was in the railway company's ordinary form, which would also be applicable where goods were not sent at owners' risk. With regard to the carriage by land the plaintiffs had, under the contract, been given the option of paying a higher rate in consideration of the railway company accepting the position of common carriers. It was contended by the plaintiffs that, the contract being for one entire transit, and no option for an alternative rate having been given in respect of the sea portion of the transit, the condition exempting the defendants from liability for negligence was not just and reasonable within the meaning of Sec. 7 of the Railway and Canal Traffic Act, 1854. On the other hand, it was said on behalf of the defendants that the land transit was not governed by the terms of the bill of lading, and that an alternative rate having been offered in respect of that part of the journey, during which the damage was incurred, the condition exempting the defendants from liability was just and reasonable. The Divisional Court, affirming the decision of the County Court Judge, held that the plaintiffs were entitled to recover, inasmuch as in respect of the sea portion of the transit, the plaintiffs not having had the option of having the goods carried by the defendants with the ordinary liability of common carriers, the condition exempting the defendants from liability was unreasonable within Sec. 7.

Mr. Justice Channell remarked that he came to this conclusion with the greatest possible reluctance, because he felt the result was obviously unjust. The plaintiffs, he added, had accepted a lower rate of carriage from the defendants for many years, and had thereby saved a sum which was probably much larger than the damage they had now suffered, but when damage did occur, they raised this point under the Railway and Canal Traffic Act. Hence the present appeal of the defendants.

Mr. Leslie Scott, K.C., and Mr. Bruce Thomas appeared for the appellants; and Mr. R. V. Bankes, K.C., and Mr. R. H. Balloch for the respondents.

In support of the appeal, Mr. Leslie Scott argued that where, as in this case, there was a low rate and alternative conditions for the whole of the land carriage, the fact that there was no alternative for the sea portion of the route, was not enough to justify the Court in coming to the conclusion that the contract as a whole was unjust and unreasonable.

Mr. Bruce Thomas followed on the same side.

Counsel for the respondents were not called upon.

Giving judgment, Lord Sumner said that the only contract between the parties was one by which the defendants were bound to accept the goods tendered to them at owners' risk rates. There was, in his opinion, an offer of an alternative, and no more. It was a continuing offer, of which the plaintiffs could avail themselves at any time, but the evidence showed that at the time in question the bill of lading as tendered at Antwerp was the only form in existence. Although there was evidence from the railway rate-book, and from the documents signed in 1910, that there was a continuing offer, in point of fact the only terms upon which the plaintiffs' goods could have been carried, were those contained in the bill of lading. It had not been contended that the transit was indivisible, nor that, as the loss had happened on the part of the transit to which the unreasonable terms of the bill of lading did not apply, the sea transit might be disregarded, because it was now accepted that this was all one transit. It had been argued that, although the existence of some alternative rate was a well-recognised criterion of the fairness of the contract, it was not the only one, and that the Court was entitled to look at the facts, and to say whether in the circumstances the contract might be just and reasonable in the absence of an alternative. In his judgment, the effect of the authorities was such that on the materials in the present case he could not say that the contract was just and reasonable, and one that would be upheld in the absence of any alternative.

Lord Justice Kennedy and Mr. Justice Lawrence concurred, and the appeal was accordingly dismissed with costs.

Dean *v.* the Prudential Assurance Co., Ltd.

In the Chancery Division, on Monday, March 23rd, Mr. Justice Sargant concluded the hearing of this action, by which the plaintiff, a maker of X-ray and electro-medical apparatus, of Leigh Place, Baldwin Gardens, Holborn, sought to restrain the erection by the defendants of a high block of buildings in Dorrington Street at the rear, which plaintiff alleged so obscured the light coming to his premises as to render them unfit for the purposes of his business.

Mr. Mark Romer, K.C., in opening the plaintiff's case, said it was not one where any damages which the Court could award could compensate him for the loss of light he would sustain; in fact, the defendants had offered him £250, but he would rather pay £250 in order to retain his light. Commencing with the discovery of the X-rays, the business had grown to such an extent that he had been some years finding suitable premises. One of the great advantages of his present premises was that they had two separate sources of electrical supply, and the factory took 100-volt current from one source which, by means of a transformer, was converted into a 200-volt alternating current, and from another source he got a 500-volt current direct.

Mr. Martelli, K.C., for the defence, submitted that the effect of their building on the plaintiff's lights would be so slight as to be easily compensated for by damages.

His Lordship, however, came to the conclusion that the plaintiff's light would be materially affected if the defendants were permitted to build as they proposed. If carried out, their buildings would cause a serious nuisance, and they had been started with little regard to the plaintiff's rights. The plaintiff had had great difficulty in finding a suitable place as he required an electrical current of large voltage for testing his apparatus, and it was doubtful whether he could find other premises where he could get the same advantages. He saw no reason for displacing his *primâ facie* right to an injunction; no damages would compensate him, and he (the judge) had no option but to grant the injunction asked for with costs.

South London Electric Supply Corporation, Ltd., *v.* Slade.

At the Lambeth Police Court recently, plaintiffs sued defendant to recover from him £3 18s. 8d., being £3 15s. for repairing a motor taken on hire from the company, and 3s. 8d. for electricity charges. The motor was hired from plaintiffs, and defendant gave notice to terminate his agreement. For plaintiffs it was stated that when the motor was sent for it was found that the starting coils were burnt out. The cost of their repair was £3 7s. 6d. plus 7s. 6d. for carriage to and from the makers' works. Evidence for the company was to the effect that the damage was due to the switch being left too long on the starting position.

Kidderminster Electric Tramways.

By order of Mr. Justice Bailhache, sitting in the King's Bench Division, the two non-jury actions, Kidderminster and Stourport Electric Tramways, Ltd., *v.* Woodward Grosvenor & Co., and Woodward Grovenor & Co., *v.* Kidderminster and Stourport Electric Tramways, Ltd., which had now been consolidated, have been ordered to be heard not before March 30th. Mr. Hugo Young, K.C., in mentioning the cases to the Judge, said that Mr. Duke, K.C., was against him, and it had been arranged, subject to the consent of the Court, that the cases that had now been consolidated should stand over till March 30th. They were figuring at present in the warned list, and he asked the Judge to consent to this course, the cases keeping their places in the list.

Mr. Justice Baillache: Yes, very well.

Collier Fined.

According to the *Western Mail*, Arthur Bridgeman (21), collier, Argoed, was summoned at Blackwood on Friday last for having an apparatus for producing a light (an electric flash lamp) in his possession at Oakdale Colliery. Defendant pleaded guilty. Mr. W. S. Nash, J.P.: Would it be possible to light a pipe or cigarette from this? Witness: Of course, there's a spark with it. Defendant was fined £3.

THE MACKAY COMPANIES.

The annual report of the Mackay Companies, dated February 16th last, has just come to hand. The trustees congratulate the shareholders that progress has been made, but the reserves have not been increased to the same extent as in the previous year.

The Postal Co. has extended its system into parts not heretofore reached, and has strung many additional wires on its poles. The Commercial Cable Co. has also renewed parts of the oldest of its three cables. No doubt the management is an able one, and the several concerns forming the Mackay Trust stand in the front rank of telegraph undertakings. The nest egg of $12,000,000 resulting from a stock transaction is still in hand. The meagreness of the accounts, however, has, we believe, caused some dissatisfaction. It would be more satisfactory to know the exact nature of the assets described as "investments in other companies" $91,997,714.19, and their market values. The British Public Companies give a plain and detailed statement of accounts, and as there cannot be anything to conceal, it is suggested that the Mackay Companies should take shareholders a little more into their confidence. Would it not, perhaps, improve the price of Commercial Cable stock?

The report deals with wireless telegraphy, and describes it as "a communication between moving points or between a fixed and a moving point," and expresses the belief that there has been no development to modify the opinion which they (the Mackay Trust) and others have already expressed that wireless telegraphy in no way threatens the supremacy of the submarine cable. In confirmation of this, the cables recently laid are enumerated, and the length laid in the last five years is given as from 247,000—280,000 miles. The cable companies have always maintained that the introduction of cheap rates—which wireless competition has probably hastened—would necessitate additional lines, and if the growth of cables has been great, truly the progress of wireless has been phenomenal. Nor is it only between moving points, but also from shore to shore, and it is difficult to believe that nations are investing huge sums in long-distance stations, if they not satisfied that the advantages warrant the outlay. Much has been achieved since the signal "S" was received, and progress continues to be recorded, not only in efficiency, but also in the lowering of rates.

The question of Government ownership of landlines in the United States has been again brought forward, and it is claimed by the trustees that such a proposition will hardly commend itself to the intelligence and fairness of the American people (British officials please note), and statements follow concerning the British Government telegraphs. The whole idea is described as a "spectre,

and a page and a-half of matter is employed to explain why it is so—intelligence notwithstanding. The subject has in recent years been so consistently brought forward that there is always the possibility of fruition. The purchase price is given at $2,000,000,000 including goodwill, and this sum suggests the remunerative nature of the service. The United States already exercises control over rates, and perhaps this is a step towards an end.

The Postal Co. view with disfavour the strong position of the Western Union Co. in Mexico, but as both companies have absorbed many smaller rivals, there is no occasion for stone-throwing. The Mexican trouble may, perhaps, yet convince the United States Government that for strategic reasons it would be well to own the telegraphic system.

LOAD, STRENGTH, STRESS AND STRAIN.

[COMMUNICATED.]

Many writers use the above four words in an incorrect manner. They are used wrongly and promiscuously also in manufacturers' catalogues; for example, we find in the latest edition of "Kempe's Year Book," tables which are credited to certain wire rope manufacturers, in which tabular figures are both correctly and incorrectly designated.

In the first place, the term "load" refers simply to any weight, pull, or push, stated in pounds, in tons, or in any other unit, to which any body may be subjected irrespective of its cross-sectional area. Thus a statement that a load of 1 ton is placed upon a 1-in. chain gives no information as to the stress, the strain, or the strength (the single word "strength" being the equivalent of "breaking load," or "breaking weight," although "breaking strength" is allowable) of that chain, unless accompanied by figures obtained from calculation or experiment.

The 1 ton is simply a load. But if the cross-sectional area in square inches be divided into the load in pounds, there will be obtained the load in pounds per square inch of area. This load is properly to be referred to as the unit stress or the stress per square inch. The term "unit stress" in British measures means tons per square inch, or pounds per square inch. For steel it usually implies tons in Britain and pounds in the United States, where, perhaps, it has become pounds to avoid the ambiguity of the ton of 2,240 lb. and the usual U.S. ton of 2,000 lb.

"Stress" is thus properly used on page 209 of the book referred to, on line 2, in the expression "breaking stress of 100 tons to the square inch." In the table below this heading, however, "stress" is wrongly used in the heading of the three columns "Guaranteed breaking stress." Here the expression should have been "Guaranteed breaking load," "Guaranteed breaking weight" or "Guaranteed strength," for every size of wire rope is made from steel of 100 tons breaking stress, but the different diameter ropes break with different loads or weights, according to their area of cross-section. Thus a 1-in. circumference rope breaks with a load of 1·75 tons at a unit stress of 100 tons, or under another set of conditions at 3·25 tons. Of course, the 100 tons stress is the test of the straight wire. The rope cannot, over a sheave, develop the strength of its individual wires. Turning to the table at the foot of page 207, wires are given certain "breaking stresses" in columns 7 and 8 of the table. In this case the heading should be "breaking loads" or "strength," for again the loads are meant which will break the different sizes of wire, and in column 7 these loads vary from 55 lb. to 10,470 lb. for wires of the same quality. In each case the stress is about 50,000 lb. per sq. in., but the breaking loads or strengths vary as the square of the diameter.

The same error appears in the first table on page 208. But in the second table on that page "stress" is properly employed to denote the unit stress in tons per sq. in. In Table III, on page 208, the heading is "Breaking stresses," which is wrong, for it should be "breaking load," "breaking weight," or "strength," as in the column headings. Thus this table is wrongly entitled and rightly carried out in detail. In the fourth table on the same page the expression "breaking stress" should be "strength" in every case. On page 210 also, the memo. employs "stress" wrongly. On page 235 there is less risk in the use of the word stress, but even in this case it is not, perhaps, quite correct, though it is permissible here, because it is only defining stresses in structures of no dimension, the dimensions of parts being intended to be calculated from these stresses, as shown on a mere diagram of centre lines. But "force" would be unambiguous, and would be preferable to stress, which should be confined to unit stresses.

A boiler ought not to be described as safe up to a bursting stress of 100 lb. This really means a tension per square inch of plate section of only 100 lb. In this case the words "bursting pressure" should be employed, meaning steam pressure in lb. per square inch of plate area.

On pages 260 and 261, "strength" and "load" will be found properly used. But on page 246 will be found "breaking strain." Here "strain" should have been "load" or "weight," for "strain" means the amount of deformation per unit dimension, produced by a given unit "stress," as when a "load" of 10 tons on a $\frac{1}{2}$-in. square bar produces a "unit stress" of 40 tons per square inch, and an "elongation" or "strain" of so much per foot of length.

Thus, in test practice, unit stresses produce unit strains, though the units may be square inches and linear inches or linear feet respectively. In the use of the word "strain" the statement of effect is really in the form of a percentage of the dimension on which the "strain" is measured, and so the amount of strain in the same specimen will vary according to the length measured, the elongation percentage decreasing as the length increases, for most strain occurs at or near the point of rupture in a tensile test on ductile material.

It is really important that the correct word should be used on every occasion, for a confusion of stress (load per unit area) and total load may arise from the improper use of "stress."

BUSINESS NOTES.

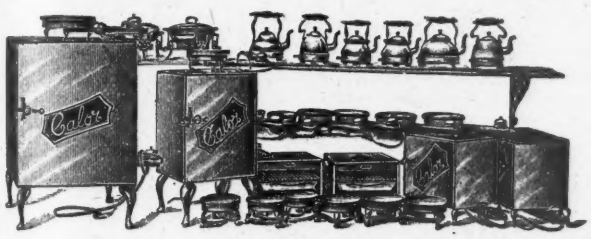
Deed of Assignment.—A. E. Hart, electrical engineer, 456, New Cross Road, S.E.—Claims must be sent by April 4th to the trustee, Mr. G. E. Corfield, of Corfield & Cripwell, 119-125, Finsbury Pavement, E.C.

Bennis's Contracts.—We have received from Messrs. E. Bennis & Co., Ltd., an imposing list of contracts that have been received by them during the last few weeks for their machine stokers. These include two for Yokohama, six for a flour mill at Karachi, two for ferryboat use for Alblasserdam, near Rotterdam, two for use with Woodeson water-tube boilers at H.M. Dockyard at Chatham, six and four respectively for two Birmingham breweries, four for a linen factory at Brechin, many more for other mills and works in different parts of the United Kingdom, and a repeat order from Keighley Corporation electricity works for two Sprinkler stokers for an 8-ft. diameter Lancashire boiler.

Westinghouse Cinema and Theatre Supplies.—During the last two weeks, the British Westinghouse supplies department, of 179, Wardour Street, W., has been holding a special exhibition of cinema and theatre electrical supplies, embracing practically everything required in the way of lighting, power and electrical specialities for this class of work. In addition to arc and half-watt lamps, the Cooper-Hewitt mercury vapour and ordinary tungsten lamp, and the many excellent types of ornamental fitting suitable for interior decorative lighting, there are shown specimens of fireproof stage fittings, stage projector arcs, bunch lights, &c., electric torches for attendants, and what would be a welcome addition in many picture theatres, small shaded lamps forming seat attachments for throwing some light on the usually dark gangways. We noted a section of specially prepared enamelled metal troughing for concealed lighting behind cornices; also a footlight innovation—an inverted float with a double casing so arranged as to safeguard the lamps from stage vibration. Amongst the sundries were various electrically-operated picture, number, and time indicators, and a manager's instruction indicator. Theatre dimmers, standby resistances, cinema motors, switchgear, fans, radiators, vacuum cleaners, and much other apparatus are included, the exhibits being well worth the attention of those interested in this growing branch of electrical work.

Van Horse Parade.—As several electrical firms are already interested in the forthcoming Easter Monday parade of the London Van Horse Parade Society, we are asked by the Society (2, Upper St. Martin's Lane, London, W.C.) to inform others who may be interested in the event that the last day for receiving entries is Tuesday, March 31st. This year a special effort is being made to secure 1,000 entries, and firms anxious to encourage drivers to take greater care of horses should obtain the Society's interested booklet.

Electric Cookers for South America.—The accompanying illustration shows one-seventh part of an order for



"Calor" electric cooking apparatus that is being executed for South America by Messrs. Townshend's Art Metal Co., Ltd., of Birmingham.

Book Notices.—"*Journal* of the Institution of Electrical Engineers." Vol. 52, No. 230. March 16th. London: E. and F. N. Spon, Ltd. Price 3s. 6d.—This issue contains the following papers:—"Electric Locomotives" (supplementary paper), and "Motor and Control Equipments for Electric Locomotives," by F. Lydall; "The Gulstad Vibrating Relay," by W. Judd; "The 'Cascade' Induction Motor," by L. J. Hunt.

"Laboratory Manual—Direct and Alternating Current." By C. E. Clewell. London: Chapman & Hall, Ltd. Price 4s. 6d. net.

"*Bulletin* de la Société Internationale des Electriciens." Vol. IV, No. 32. February. Paris: Gauthier-Villars. Price 2 fr. 50 c.

"The Elements of Electricity." By W. Robinson. London: Chapman & Hall, Ltd. Price 10s. 6d. net.

"*Transactions* of the Institution of Engineers and Shipbuilders in Scotland." Vol. LVII, Part 5. March. Glasgow: The Institution.

"*Journal* of the American Society of Mechanical Engineers." Vol. 36, No. 3. March. New York: The Society.

"*Journal* of the Western Society of Engineers." Vol. XIX, No. 1. January. Chicago: The Society. Price 50 cents.

"*Journal* of the Franklin Institute." Vol. CLXXVII, No. 3. March. Philadelphia: The Institute. Price 50 cents.

"*Bulletin* Scientifique de l'Association des Elèves des Ecoles Spéciales." Vol. 16, No. 4. February. Liége: Lahaye & Co. Price 1 fr.

"*Proceedings* of the South Wales Institute of Engineers." Vol. XXIX, No. 7, and Vol. XXX, No. 1. March 20th. Cardiff: The Institute. Price 2s. 6d. each.

"*Memoirs* of the College of Science and Engineering." Vol. V, No. 9, and Vol. VI, No. 1. Kyoto, Japan: The Imperial University.

Catalogues and Lists.—Messrs. Fredk. Ryman & Co., 116, Livery Street, Birmingham.—Twenty-two-page illustrated and priced stock list of wood blocks, switches, lampholders, fuseboards and fuses, &c.

The Selson Engineering Co., Ltd., 85, Queen Victoria Street, London, E.C.—Fifty-six-page catalogue showing excellent half-tone illustrations (art paper) of a selection of machine tools (shaping and milling machines, lathes, drilling, tool-grinding and other machines), such as are regularly stocked by them in London.

The Edison & Swan United Electric Light Co., Ltd., Ponder's End.—Abridged catalogue of about 100 pages, giving brief particulars, with illustrations and prices, of "Royal Ediswan" lamps (half-watt, "Downlite," &c) accessories, cables, wires, conduits, brackets, ship and majolica fittings, shades, instruments, fans, radiators, indicators, bells, pushes, telephones, signs and carbons. The items are more briefly given than in the firm's original catalogue.

Messrs. T. W. Ward, Ltd., Albion Works, Sheffield.—March catalogue of close upon 400 pages giving particulars and prices of new and second-hand machinery and boilers, tanks, tubing, rails, &c., in stock.

The Hoyt Metal Co. of Great Britain, Ltd., 26, Billiter Street, London, E.C.—Leaflet giving directions for using their I.C.E. metal, and hints on the lining of bearings; the latter are notes on tinning, heat, pouring, jigs, machining, &c., intended for the practical man.

The Electrical Co., Ltd., 122-124, Charing Cross Road, London, W.C.—Sixteen-page sectional list giving fully illustrated and priced information respecting their "Striplite" electrical illumination material.

Messrs. W. B. Coupier & Co., 19-23, Oxford Street, London, W.—Four-page priced leaflet, illustrating a variety of designs of silk shades for electric candle and other fittings, also showing the "Kingolite" candle. Copies of the leaflet can be supplied to firms in the trade overprinted with their own names.

Messrs. Siemens Bros. & Co., Ltd., Woolwich, S.E.—Leaflet No. 531.1, giving a brief description, with prices, of their Leclanché cell for use in connection with railway track circuits.

Messrs. Drake & Gorham, Ltd., 66, Victoria Street, London, S.W.—Three illustrated and priced descriptive pamphlets as follows:—No. 218, dealing with transformers (air-cooled 2,200-volt, oil-filled up to 650 volts, and air-cooled house up to 250 volts); No. 219, devoted to "half-watt" lamps (Mazda, Wotan, Nitra, Osram, and Ediswan), and lanterns and fittings for use with same; and No. 220, showing several types of electric grinding and drilling machines.

The Electric Suction Cleaner Co., 151, Queen Victoria Street, London, E.C.—Attractive 12-page pocket pamphlet, giving various illustrations of their new model "Frantz" electric suction cleaner, its parts and applications.

Messrs. Henrion Carbons, 34, Victoria Street, London, S.W.—Tabulated price list of carbons for cinematograph and projection work.

Messrs. E. Brook, Ltd., 178, Gray's Inn Road, London, W.C.—Forty-page book of half-tone pictures showing views of machinery of all kinds in all classes of factories, driven by Brook electric motors with ball bearings.

Messrs. W. and R. Jacobs, 39c, King William Street, London, E.C.—Eight-page pamphlet containing neat little illustrations and tabulated prices of artistic bead cascade shades for electric light.

Messrs. Wailes, Dove & Co., Ltd., Newcastle-on-Tyne.—28-page pamphlet, giving information relating to their patent "Bitumastic" solution for prevention of corrosion of iron and steel structures. The North Wales Power Co.'s pipe line and that of the British Aluminium Co., at Kinlochleven, are both shown among the illustrations.

Brimsdown Lamp Works, Ltd., Kingsway House, Kingsway, London, W.C.—12-page illustrated price list of Wirum battery lamps of various types and for various voltages and candle-powers. All the lamps are manufactured at Brimsdown, where further extensions to the works have been made.

Messrs. Ferranti, Ltd., Central House, Kingsway, London, W.C.—Small pamphlet, for enclosure with correspondence, accounts, &c., respecting electric fires and electric cooking. The loss of meat with different systems is graphically shown, and the current and coal bills are reproduced comparatively of a household of five persons before and during the use of electric cooking and heating. Contractors and supply authorities can have quantities of this publication on application.

Private Arrangements.—Albert George Mead and Cecil Herbert Jeffery (trading as Mead & Jeffery), electrical engineers, 23, The Avenue, West Ealing.—The creditors interested herein were called together on March 20th, when the statement of affairs presented showed liabilities of £388. The indebtedness to the trade was £338, and there were cash creditors for £50. The assets were estimated to realise £500, and the estate thus showed a surplus of assets over liabilities of £112. The assets were as follows:—Stock-in-trade at cost £197, expected to produce £158; fixtures and fittings £23, valued at £15; household furniture £40; good book debts £267, expected to produce £227; doubtful and bad debts £163, estimated to realise £20: and cash at bank £40. In addition to the assets shown on the statement, the debtors possessed a lease of the premises which had a number of years to run at a rental of £60 per annum. A portion of the premises were sublet at a rental of £70 per annum. It was stated that the debtors started business in May, 1910, at Gordon Road, with a capital of £50. They removed to their present premises in May, 1913, spending £50 in alterations. The turnover had gradually increased, and the profits also were larger year by year. Last year they made a bad debt of over £130 in connection with a company that went into liquidation. The drawings had been moderate. No definite offer of a composition was made, but it was stated that the debtors desired to discharge the whole of their liabilities in full. After some discussion, it was decided that the debtors should be allowed to continue the business for a period of three months, and at the expiration of that time a trading account should be prepared and submitted to the three largest creditors. The following are creditors:—

Sloan Electrical Co.	£140	Siemens Bros.	£22
General Electric Co.	43	Strauss & Co.	17
Falk, Stadelmann & Co.	48	Jeffreys	48

Bankruptcy Proceedings.—T. M. Woodcock, electrical engineer, 64, Holly Street, Sheffield.—Receiving order made March 18th on debtor's own petition.

M. Zains, "electrical engineer and tobacconist," 98 and 105, Wardour Street.—Application for debtor's discharge will be heard at Carey Street on April 7th.

Charles Blake, electrical engineer, of Church and Oxford Streets, Bilston.—At Wolverhampton Bankruptcy Court, on March 18th, this bankrupt again appeared before the Registrar of the Court (Mr. C. B. Cope), and was further examined by the Official Receiver (Mr. Sam. Wells Page). Debtor, in reply to questions, said he had kept no record of cash sales except special items. He had no record of petty expenses, which he estimated at £1 a week. The Official Receiver said he had added up the figures, and found that the total receipts were £622, and the total payments £849, so that debtor had paid away over £200 more than he had received. The Official Receiver suggested that the statement of receipts was inaccurate, and he added that the figures did not show the amount of the deficiency. The examination was adjourned to close.

E. J. Crosier, Newcastle-on-Tyne.—Date of release of trustee (Mr. J. A. Gardner) February 16th.

The Aero and Marine Exhibition.—Quite a number of firms were exhibiting petrol and paraffin lighting sets at the Aero and Marine Exhibition which closed on Wednesday last (25th inst.), at Olympia, the plants being suitable not only for the lighting of ships, steam and petrol motor-boats and yachts, but also for country house lighting, cinematograph theatre lighting and wireless telegraphy. Among the firms displaying such sets were the Aster Motor Co., Ltd., Wembley; the Austin Motor Co., Ltd., Northfield, Birmingham; Alvaston Motors, Derby; the Bristol Wagon and Carriage Co., Ltd.; Messrs. Boulton & Paul, Ltd., Norwich, whose exhibit included a 4½-H.P. set for the King of Siam.; Messrs. Brazil, Straker & Co., Ltd., Bristol; Messrs. W. H. Dorman & Co., Ltd., Stafford; Messrs. Dixon Bros. and Hutchinson, Ltd., Southampton; Gleniffer Motors, Ltd., Anniesland, Glasgow; the Green Engine Co., Ltd., London; the Parsons Motor Co., Ltd., Southampton; and Messrs. Thornycroft & Co., Ltd., Basingstoke; Rushmore Lamps, Ltd., showed the Rushmore lighting dynamo and engine starter, as also a range of deck electric lamps and searchlights; Messrs. Arthur Lyon & Co., of Caxton House, Westminster, also displayed a special dynamo for boat lighting as well as searchlights, visual signalling apparatus, and a wireless signalling set. Finally, reference may be made to the exhibit of the Rouzet system of wireless telegraphy for use on aeroplanes, seaplanes, and airships, which has been introduced into this country by Mr. Alfred Tiano, of Warnford Court, Throgmorton Street, E.C.

A New "Underground" Poster.—The latest Underground poster takes the form of a large topographical map of the Metropolis, by Mr. Macdonald Gill, in the making of which the draughtsman has given unrestricted licence to his sense of humour. The idea is a novel one, and full justice has been rendered to its possibilities. The principal thoroughfares and buildings, the parks, the river, and the Underground stations are shown, and the life of London in various phases has been dealt with by the artist, after the fashion of the Middle Ages, every district being made to contribute its share of parodied characteristics. The poster is sure to arouse more than ordinary attention wherever it is exhibited.

Annual Dinner.—The directors of Electrical Installations, Ltd., entertained some 100 members of the staff and guests at their seventh annual dinner, held last Saturday at the Hotel Europe, Leicester Square. A high class musical entertainment followed. Mr. H. F. Simon was in the chair, and he referred to the prevalent labour unrest in the electrical contracting industry. Several other gentlemen also spoke, and the entertainment was voted the most successful yet given by the company.

Trade Announcements.—Messrs. Electrical Installations, Ltd., 37, Martin's Lane, Cannon Street, E.C., notify that their telephone number is now 3897 City (3 lines).

Messrs. Lester B. Betts & Co., Ltd., of 9, London Street, E.C., have been appointed sole export agents for the Colonies and England for the Hurst Electric Manufacturing Co., of Belfast.

An Indian Invitation.—The Lahore Electric Supply Co., Ltd., is about to open an extensive showroom at its generating station, and it invites manufacturing firms who would like to be represented therein to communicate with it. See our advertisement pages to-day.

Exhibition in Germany.—Arrangements are in hand for the holding of an Electrical Exhibition in Frankfort-am-Main from August 15th to September 6th next.

LIGHTING and POWER NOTES.

Aberbargoed.—The Rhymney Valley and General E.S. Co. has applied to the B. of T. for consent to the supply of electricity in the town by means of overhead wires, at a pressure of 230 volts.

Aboyne.—E.L. Scheme.—Lady Cowdray has decided to withdraw her opposition to the E.L. scheme which extends to a portion of her Birse estate.

Aldershot.—Proposed New Plant.—The electrical engineer has advised the U.D.C. that it will shortly be necessary to augment the plant at the electricity works, and the engineer and members of the Council are to visit places where plants similar to that proposed are at work, and report.

Bedford.—The Electricity Committee has been recommended to extend its electricity mains to the works of the Bedford Engineering Co., at a cost of £180; a minimum revenue of £60 per annum has been guaranteed.

Bingley.—A canvass is to be made of probable users of electricity in Bailey Hills, with a view to extending the supply to that district.

Brazil.—A concession has been granted to Sr. Brandáo for the utilisation of hydro-electric power from the upper reaches of the S. Francisco River. The capital of the concessionaire or of the company working the concession is to be £1,000,000.—*Board of Trade Journal.*

Bury.—The Electricity Committee is applying to the B. of T. for sanction to erect overhead wires to cope with the demand for current in the Woolfold district.

Colwyn Bay.—Proposed New Generating Station.—The U.D.C. has confirmed a scheme for the erection of a new electricity generating station in connection with the destructor at Bronynant. The estimated cost is £21,000, and the Lighting Committee pointed out that the present station, which would be used for distribution purposes, would require extensions costing about £10,000 by 1915. The scheme is to be submitted to a consulting engineer. The North Wales Power and Traction Co. has offered to supply electricity to the Council, and is to supply particulars of its proposal.

Continental Notes.—Austria-Hungary.—The East Bohemian Parschnitz overland electricity station has commenced operation, and supplies the Trantenau, Hohenelbe, Braunau and Koniginhof districts. It is proposed that the West Bohemian Pilsen overland station should first supply Pilsen, Blowitz and Rokitzan, and later Kralowitz, Prestitz and Zbirow. The cost of the initial network is estimated at 1,140 million kn. An association of municipalities in Central and North Bohemia has been formed to undertake the erection of an overland station on the Mittelelbe. —*Prager Tgblt.*

A union has been formed at Prague of 12 Czech administrative districts in Middle and Northern Bohemia for the construction of a joint electrical generating station on the Lower Elbe.

The Bau- und Betriebsgesellschaft für Centralanlagen, of Chemnitz, is about to build a large electrical generating station at Tepl, in Bohemia, to supply the towns in the neighbourhood of Tepl and some 14 adjacent districts.

Belgium.—The Socié.é de la Charbonnage de Sacre Madame has decided to convert all the machinery at its collieries for electric operation, the current being taken from the Société de l'Electricité du Bassin de Charleroi.

Germany.—The Bremen municipal authorities are reported to have ordered two 5,000-H.P. six-cylinder vertical Diesel engines and 7,000-volt A.C. generators as additions to the electricity supply plant of that city.

Norway.—It is reported from Hardanger that an "all-electric" dairy—the first in the country—is to be erected by a company formed for that purpose.

According to the annual report, the extra load thrown on the Kristiania municipal electrical works during the last year, due to new installations, amounted to 2,480 KW. for lighting and 3,147 KW. for power. The maximum load reached 13,578 KW., instead of 15,000 KW., as anticipated, and the total KW. installed was 29,737.

Dundee.—Year's Working.—The gross profit of the Corporation electricity department for the past year was £24,931, a decrease of £1,465, chiefly accounted for by reductions in the price of electricity. The total number of units sold was 10,050,880, an increase of 1,696,414, and the working costs were £27,459, an increase of £4,489, a third of which is represented by fuel, which increased in price by 40 per cent.

Edinburgh.—B. of T. Inquiry.—An inquiry was conducted last week by the Hon. T. H. W. Pelham into the applications of the Edinburgh Corporation to supply electricity to Cramond, Corstorphine, Colinton, Liberton and Newton, and of the Colinton Tramways Co. to supply electricity to Colinton and Corstorphine. The County Council favoured the Corporation's proposal.

The proposal of the E.L. Committee to insert a clause in the Draft Edinburgh E.L. (Extension) Order to allow it to apply the net surplus in any year to any of the purposes of the undertaking, including the formation of a fund for working capital, has been adopted by the T.C.

Epsom.—Rural Electricity Supply.—An inquiry was held at the B. of T. last week by Mr. Booth into the application of Mr. Gilbert Allom for a prov. order for the supply of electricity in the parishes of Banstead, Walton-on-the Hill, Kingswood and district. The proposal was to obtain electricity in bulk from Leatherhead, and possibly Sutton, and to supply it to the district mentioned for lighting purposes at 8d. per unit, with a primary charge of 13s. 4d. per quarter. The proposal was opposed by the Epsom and Reigate R.D.C.'s., but eventually an agreement was reached.

Guisborough.—Proposed E.L.—The Cleveland E.P. Co. has informed the U.D.C. that it is prepared to supply electricity to private consumers in the town if the latter will undertake the wiring at the same charges as are in force at Carlin How. Inquiries are to be made.

Hastings.—The T.C. has adopted the following scale of charges for outside lighting at cinematograph theatres:—4½d. per unit up to 5,000 units per annum, 2d. per unit between 5,000 and 10,000 units per annum and 1½d. per unit above that. The consequent reduction in revenue is estimated at £270 per annum.

Hornsey.—Proposed Loan.—The B.C. is seeking sanction to borrow £13,744 for the erection of the first section of the sub-station at Fortis Green.

Heckmondwike.—Increased Charges.—The U.D.C. has increased the price of electricity for lighting purposes to 5d. per unit, and for power by 50 per cent., the sliding scale to remain in force, with discounts of 20 per cent. The new scale comes into operation on May 1st.

The Council has received sanction from the L.G.B. to the whole of the loans asked for in respect of the electricity undertaking. This grant is significant in view of the application of Dewsbury to incorporate Heckmondwike.

Hinckley.—B. of T. Inquiry.—An inquiry has been held this week into the application of the Midland Electric and Light and Power Co. for a prov. order to supply electricity for lighting in the parishes of Barwell and Earl Shilton in the Hinckley R.D.C. The opposition pointed out that the parishes were being supplied by the Leicestershire and Warwickshire Electrical Power Co., and that this was the same concern as was applying. The Inspector commented on the unprofitable character of such a district, and the unliklihood of competition there.

Ilford.—The U.D.C. has decided to oppose the Bill conferring further powers upon the North Metropolitan E.P. Supply Co., and the North Metropolitan E.P. Distribution Co.

Kettering.—Loan Sanction.—The U.D.C. has received the consent of the L.G.B. to a loan of £12,000 for electricity works extensions.

Llanfair Caereinion.—E.L. Scheme.—A town's meeting has decided to proceed with the proposed E.L. scheme.

London.—Battersea.—The Electricity Committee has recommended the B.C. to sanction the expenditure of a further £500 upon the outside lighting hire scheme.

The L.C.C. has been recommended by its Finance Committee to sanction the borrowing by the Woolwich B.C. Electricity Department of £1,841, as to £934 for mains and £907 for transformers and switchgear; and of £7,280, as to £1,200 for mains, £880 for services, £740 for meters and £4,460 for electrical apparatus to be supplied on the hire-purchase system. The St. Marylebone B.C. having decided not to take up the loan of £10,825 granted in November, 1913, for the purpose of its electricity undertaking, the L.C.C. has been recommended by its Finance Committee to cancel the same.

Hackney.—The Finance Committee of the B.C. proposes to transfer £2,500 from the estimated surplus of £7,848 on the electricity undertaking for the year ended March 31st next to the credit of the reserve fund, the balance to go in aid of the rates.

Manchester.—Street Lighting.—The Electricity Department has fixed four half-watt lamps at the junction of Market Street and Cross Street. It is intended to suspend similar lamps from the tramway poles in Oxford Road; centrally-suspended arc lamps are to be fixed from Whitworth Street to Deansgate.

Mansfield.—Loan Sanction.—The T.C. has received sanction to the borrowing of the following for the purposes of the electricity undertaking:—£2,000 for mains, £1,000 for services, £1,650 for boiler, superheater, &c., and £350 for mechanical stoker and driving.

Middlesbrough.—Negotiations are proceeding between the Lighting Committee and the Cleveland and Durham E.P. Co. in respect of a supply of electricity for lighting purposes at North Ormesby.

Middleton, near Teesdale.—Proposed E.L.—Mr. Best, who is promoting an E.L. scheme for the parish, has applied to the Durham C.C. for consent to the erection of posts for overhead wires.

Peterboro'.—Proposed Loans.—The T.C. has decided to increase its application to the L.G.B. for borrowing powers by £1,000 for mains, and £600 for services, in connection with electricity extensions.

Peterhead.—Proposed E.L.—As a result of the circulars which the manager of the gas works issued to gas consumers to find out whether they were inclined to adopt the electric light, and in which he took the precaution to inform them that electricity would cost twice as much as gas, only 50 favourable replies have been received.

Rochdale.—Loan Sanction.—The L.G.B. has sanctioned the loan of £65,000 for extensions of buildings and plant at the electricity works.

Southend-on-Sea.—A Surcharge.—The District Government auditor recently disallowed a payment of £9 5s. 4d. for the expenses of the electrical engineer in attending a conference at Harrogate. The T.C. appealed to the L.G.B., which has remitted the surcharge to the extent of £8 7s., with an intimation that it will not grant remission of any part of any future surcharge on similar expenditure. As to the balance of 18s. 4d., the L.G.B. considered that the engineer should refund it, and the Council has requested him to do so, as it constituted his personal expenses at the conference.

Southampton.—Hiring Charges.—Owing to the rental of electric radiators being increased by the T.C. to 10s. per annum, some 160 radiators have been returned, and it has been decided to revert to the original charge of 4s. per annum for old pattern radiators, the new ones to remain at 10s.

Stockton-on-Tees.—The T.C. has decided to supply electricity to the flour mill of the Co-operative Society on a load factor basis at 25s. per KW. per quarter. The average price per unit will be ·54d., subject to a five years' agreement, and a minimum annual consumption of 300,000 units.

Swansea.—Rate Relief.—The B.C. has decided to act on the recommendation of the Finance Committee (see page 485) and allocate £2,200 out of the estimated profit of £2,500 on the electricity undertaking to the relief of the rates.

Torpoint.—E.L. Scheme Adopted.—The U.D.C. has adopted an agreement with the Electricity Co. for a supply of electricity for five years. Doubt was expressed as to whether the proposed company would be formed.

Tynemouth.—Year's Working.—The profit on the electricity undertaking for the year just ending is stated to be about £1,000, in spite of the revenue being reduced by £700, due to the reduction of the price of current.

Wallasey.—Loan Sanction.—The L.G.B. has sanctioned a loan of £65,000 for the erection by the Corporation, of a new electricity station in Poulton, which is to be completed by about the end of the year.

Warwick.—Sewage Pumping.—The T.C. has decided to take a supply of electricity for power purposes for the sewage farm from the Electrical Co. on a yearly payment of £300.

Wem.—The U.D.C. has retained Mr. A. J. Leigh as consulting engineer in connection with the proposed electric lighting scheme.

TRAMWAY and RAILWAY NOTES.

Continental Notes.—Hungary.—The Danube Steamship Co., which owns collieries at Funfkirchen, Hungary, has decided to convert its 12½ miles of tramway from the mines to the railway at Mezog to electric traction.

Russia.—According to the *Russ. Handelsnachr*, the electrification of the Baltic and Warsaw railways is to be commenced in the spring of 1915. The total expenditure involved amounts to 15 million roubles. The lines to Siverskaja, Gatschina and Oranienbaum will be converted first.

Darlington.—Year's Working.—The total revenue of the Corporation tramways department for the year just completed was £11,833, an increase of £334 upon the previous year. The passengers carried numbered 3,790,000, an increase of 16,000. The car-mileage was 380,400, and the receipts were 7·43d. per car-mile.

Dearne Valley (Yorks.).—Tramway Scheme Approved.—Subject to certain modifications, the Light Railway Commissioners have approved of the proposed Dearne Valley light railway scheme, which is being promoted by the Wombwell, Wath, Bolton and Thurnscoe Councils.

Dundee.—Year's Working.—The Corporation tramways undertaking shows a gross profit of £25,623 for 1913. The net profit was £10,764, an increase of £2,300 on the previous year, and the passengers carried numbered 17,734,162, an increase of 700,000.

The B. of T. inspection of the extension of the Blackness Road tramway line took place last week. The new section cost £5,000 to construct and equip. It is intended to double part of the tramway track at Morgan Academy.

Edinburgh.—Tramway Extension Dropped.—On the grounds that the route could not be made to pay, the T.C. has adopted a motion to delay the proposed tramway extension to Corstorphine.

Huddersfield.—Tramway Extensions, &c.—The B. of T. has sanctioned the doubling of the tramway track from Fartown Green Road to Smithy.

The Tramways Committee is to meet a deputation from the South Crosland U.D.C. with reference to the proposed extension of the tramways to Netherton.

The Corporation proposes to lay a double line of tramway along New Hey Road.

Japan.—The Tokio Municipal Assembly has passed a project for the construction of a suspended electric tramway—an aerial ropeway—from Ueno to Asakusa.

Liverpool.—Proposed Tramway Goods Traffic.—In a report on a proposal to inaugurate a service of tramway wagons and trailers for the conveyance of goods, the tramway manager, who has been instructed to enter into negotiations with other tramway authorities interested, says that the most that could be done with the existing lines would be to run three or four goods tramcars per day. If found successful, a more elaborate system could be established, providing that the Dock Board and the Bootle Corporation were prepared to grant the necessary facilities, and and that at least 1,314,000 tons of traffic per annum was guaranteed, which at, say, 2½d. per ton per mile by the new system, would

provide a revenue of £105,394 per annum. The scheme would involve the electrification of the dock railway or the construction of a line of tramways parallel with it, and the construction of tramways for dealing with the traffic between Alexandra Dock and Brunswick Dock and Knotty Ash, at a total cost of £246,750. The South Lancashire Tramways and Prescot Light Railway has promised to co-operate with the Tramways Committee in any scheme it may bring forward for the transport of merchandise over its system.

Manchester.—A Tramway Report.—As a result of his investigations into the tramway systems of the chief Continental and American cities, Mr. McElroy, general manager of the Corporation tramways department, has now prepared a report dealing with the passenger transport problem in Manchester. He recommends the construction of new arterial routes; the provision of new tramway termini on the old infirmary site, in Albert Square and St. Peter's Square, in High Street, and in Cannon Row; the opening up of negotiations with the Salford Corporation regarding the tramway traffic entering from that side; and the introduction of a limited system of transfer tickets. The report indicates that if the Tramways Department is to develop the transit facilities of the city, a limit must be placed for a time upon the amount applied from the revenue to rate relief, which should not exceed £100,000 per annum. The construction of underground railways and underground subways for tramcars cannot be justified on account of the great initial cost, unless a very large traffic is dealt with. Other points to be considered by the Tramways Committee are improvements in the loading and unloading of cars; the number of stopping places to be reduced in order to increase the speed of the cars; the simplification of fare collecting; and the provision of shelters and refuges. The report does not favour elevated rapid-transit lines, but declares that, in the near future, Manchester will have to be provided with rapid-transit facilities, preferably to work in conjunction with the surface lines.

Rochdale.—Tramway Accident Inquiry.—On Tuesday, Lieut.-Col. Druitt concluded an inquiry into the tramway accident in John Street on February 14th. The driver of the car stated that on the night of the accident he examined the brakes and sanders and found them in good condition. In John Street the rails were very greasy, and when he released the hand-brake he found that the wheels were not revolving. He reversed the motor, but the trolley came off and he was then practically helpless. He did not try the magnetic brake before reaching John Street. Col. Druitt subsequently inspected the sanding apparatus.

Stafford.—The Potteries Electric Traction Co. is installing a service of motor-buses to run in conjunction with the tramways on routes which are at present overcrowded. The company is also opening a 'bus service between Tunstall and Biddulph and Tunstall and Talke.

Stoke-on-Trent.—Electric Vehicles.—The Cleansing sub-Committee has, we learn, decided to make a trial with a Fram electric street sweeping machine.

U.S.A.—The Commonwealth Edison Co., of Chicago, has reduced the maximum price for electricity for charging electric vehicle batteries in public garages from 2½d. to 2d. per KW.-hour except between the hours of 4 p.m. and 8.30 p.m. during November, December, January and February.

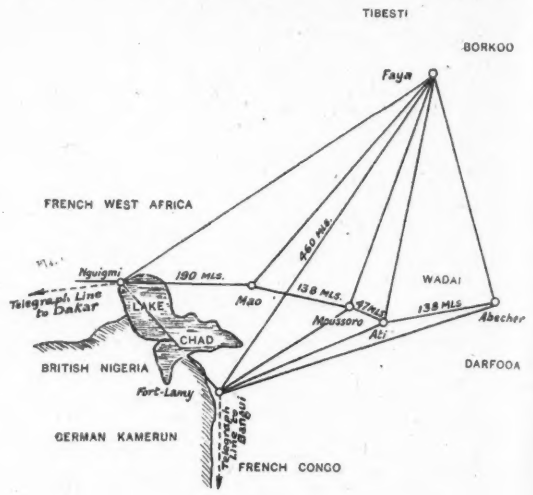
West Ham. — Standardisation of Cars. — The Tramways Committee has decided to obtain 15 covered bogie tramway cars, of the L.C.C. type, and to standardise as far as possible on two classes of cars, using standard trucks, equipments and bodies. These will include single truck cars to carry 60 passengers and bogie cars to carry 78 passengers, the former with not less than 35-B.H.P. motor equipment and the latter with not less than 45-B.H.P. equipment. Arrangements are to be made to replace 70 controllers with the new standard type.

TELEGRAPH and TELEPHONE NOTES.

Imperial Wireless System.—During the week the Select Committee of the House of Lords has continued the inquiry into the allegations against Lord Murray. On Tuesday last Lord Murray himself gave evidence.

Marconi Wireless Patents.—The action brought by the Marconi Wireless Telegraph Co. of America against the National Electric Signalling Co. (Fessenden's system) in the United States Circuit Court for infringement of Lodge's patent No. 609,154 (corresponding to English patent No. 11,575 of 1897, which has been prolonged for seven years) and Marconi's patent No. 763,772 (corresponding to English patent No. 7,777 of 1900, which was upheld in the English Courts a few years ago) ended, on the 18th inst., in a judgment for the plaintiffs. The judgment, which corresponds with those which have been delivered in other countries, declares both patents to be valid, and to be infringed by the defendants' system.

Wireless at Lake Chad.—An important network of seven wireless stations has recently been completed in the neighbourhood of Lake Chad, with a view to improving military communication in this district. It would be practically impossible yet to establish telegraphic communication by wire in this locality; certainly the volume of traffic would not justify the capital expenditure and risks incurred in erecting and maintaining a line. Six small radio-stations have therefore been installed. Each was designed for a range of 200-300 km., and since coolie transport had to be depended on for several hundreds of miles, the equipment was ordered for delivery in hermetically sealed cases each weighing not more than 154 lb. total. Each station was provided with two 98½-ft. steel masts, a 5-H.P. petrol motor and a 1,000 cycles per second Bethenod alternator. The condenser capacity = 0·05 mfd. in each case, and the note of the spark can be altered by varying the



alternator excitation. The six southern stations (see map) were completed early last year, and connect to the French West and Central African telegraph networks at Nguigmi and Fort Lamy respectively. To the difficulties and discomforts of transport were added technical difficulties due to climatic conditions generally, and ionisation of the atmosphere in particular. With 1,300-m. waves, the maximum range by day was 150 km. (95 miles); with 3,500-m. wave length, good communication was established up to 650 km. (410 miles), despite the small power available. Wooden masts 33 ft. in height were mounted on top of the metal masts; the antennæ are of the horizontal sheet type, and earthing is improved by utilising the sheeting of the transport cases as ground plates. The seventh station (at Faya) was constructed of spare parts provided for the other six stations. Communication was at once established with Wadai, and then with Fort Lamy (455 miles). In recognition of the great difficulties which he overcame in completing this important service, it is proposed to admit Captain Chaulard to the Legion of Honour.

Wireless at Sea.—An Association of Wireless Telegraphists has been formed, consisting of operators on board ship, who allege that they are paid on a lower scale than anyone else at sea (20s. to 35s., some 55s., a week).

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—Newcastle.—April 29th. P.M.G. Electrically-controlled clocks at Post Office, Newcastle, N.S.W. Schedule No. 361. See "Official Notices" March 20th.

May 12th. P.M.G.'s Department. Standard batteries for all States; Schedule No. 1,010. See "Official Notices" to-day.

Victorian Railways.—May 13th. One hundred enclosed arc lamps. Deposit £5. Mr. E. B. Jones, acting secretary.

Austria. — Nadworna.—Installation of public and private electric lighting and a water supply service. Tenderers must submit their own plans and specifications. Particulars of the Stadtgemeinde, Nadworna, Galicia.

Sniatyn.—Installation of an electric lighting service, erection of a generating station, &c. Particulars of the Magistrat in Sniatyn, Galicia.

Bedford.—April 1st. Corporation. 12 months' supply of high and low-tension cables; one-phase A.C. induction house service meters; metal-filament lamps. See "Official Notices" March 13th.

Belgium.—April 9th. The municipal authorities of Schaerbeek (Salle du College, 30 Rue de la Ruche) are inviting tenders for electricity meters and electric cables.

Bray.—April 7th. U.D.C. General stores and stores for electric light works. See "Official Notices" March 13th.

Carlisle.—April 1st. Ironmongery, packing and jointing materials, oils, &c., for a year, for the Corporation Electricity Department. Mr. F. W. Purse, Electrical Engineer, Victoria Viaduct (returnable deposit of 5s. for each schedule).

Devonport.—April 8th. 1,250-KW. turbo-alternator, with condensing plant, two 500-KW. rotary converters and switchgear, for the Borough Electricity Department. See "Official Notices" March 20th.

Dublin.—March 30th. G.N.R. of Ireland. Re-plating of electric battery in connection with Hill of Howth electric tramway. See "Official Notices" March 13th.

Edinburgh.—March 30th. Three or twelve months' supply of coal (washed singles, washed pearls, and washed or dry small dross or gurn) for the Electricity Department. Specifications, &c., from Mr. F. A. Newington, Dewar Place.

April 6th. Midlothian and Peebles Asylum. Six months' supply of electric fittings. Forms of tender from the Clerk and Treasurer, 19, Heriot Row.

Glasgow.—April 7th. Twelve months' supply of stores, fuel, &c., for the Tramways Department. Specification from Mr. J. Dalrymple, General Manager, 46, Bath Street.

Gloucester.—Low-tension, paper-insulated cable, for the Electricity and Tramways Committee. See "Official Notices" to-day.

Holywell.—Electric light installation, workhouse infirmary, for the B. of G. Mr. A. J. Leigh, Northwich.

Kirkcaldy.—Tenders are to be submitted to the Tramway Committee for four new cars with glass weather screens.

Keighley.—March 31st. Cabling for electric lighting, &c., at Technical Institute extensions. See "Official Notices" to-day.

London.—L.C.C. April 9th. Installation of 65 wiring points, 85 lights, and two power points, at Moxey Road centres, Woolwich. See "Official Notices" March 20th.

Manchester.—March 30th. Telegraph and electric fittings and electric light wires for a year, for the Lancs. and Yorks. Railway Co. Mr. Waring, Stores Department, Osborne Street, Manchester.

Portsmouth.—2,000-KW. turbo-alternator complete, for Borough Electricity Department. See "Official Notices" to-day.

Rathkeale (Co. Limerick).—April 18th. Gas engines and suction plant, dynamos, storage battery, switchboard, overhead lines and street lamps, for Rathkeale Electric Lighting and Power Co. See "Official Notices" to-day.

Rochdale.—April 15th. Corporation. Boiler feed pumps and crane. See "Official Notices" to-day.

Russia.—MARIUPOL.—May 14th. Concession for the building and working of an electric tramway. Particulars of the Municipality, Mariupol, Province of Ekaterinoslov, Russia.

Servia.—April 3rd. The Servian Ministry of Public Works, in Belgrade, is inviting tenders for 1,000 metres of insulated telephone cable.

Shanghai.—March 30th. The Municipal Council is inviting tenders for two motor-driven fire pumps. Particulars from Messrs. J. Pook & Co., 68, Fenchurch Street, E.C.

Spain.—April 5th. The municipal authorities of Bercero (Province of Valladolid) are inviting tenders for the concession for the electric lighting of the town.

Switzerland.—LAUSANNE.—The Kreisdirection of the Swiss Federal Railways in Lausanne is prepared to receive tenders for the supply of sundry electrical material (wire, insulators, brackets, &c.). Particulars from the Kreisdircetion der Schweiz. Bundes Bahnen, in Lausanne.

Tunbridge Wells.—April 30th. Corporation. Supply of 4,000 tons of small coal for use with underfeed stokers. Specifications from the Borough Electrical Engineer, Electricity Works, Stanley Road.

Wallasey.—April 7th. Economisers, extra-high-tension cables, extra-high-tension switchboard, engines, alternators and condensers, hand-power overhead travelling crane, rotary converters, transformers, water-tube boilers, for the Borough Electricity Department. See "Official Notices" March 13th.

Wigan.—April 18th. Corporation. Electrical accessories, service boxes, cables, &c. See "Official Notes" to-day.

April 20th. Corporation. H.T. feeder cable, transformer and switchgear. See "Official Notices" to-day.

Warrington.—March 31st. 750-KW. rotary converter; E.H.T. switchboard panel, for Electricity and Tramways Committee. See "Official Notices" March 6th.

April 14th. One year's supply of motors and transformers, for the Borough Electricity Dept. See "Official Notices" to-day.

CLOSED.

Accrington.—The Corporation of Accrington has just placed a contract with Leyland Motors, Ltd., for a 30-H.P. motor tower wagon for the use of the electrical department.

Australia.—P.M.G.'s Department:—

NEW SOUTH WALES.—25,000 Pattern B insulators, £312.—Firebrick and Insulator and Pottery Co.
75,000 galvanised-steel spindles for use with Pattern B insulators, £1,250.—Williams & Co.
13,000 galvanised-steel spindles for use with Pattern A insulators, £318.—McPherson's Pty., Ltd.
VICTORIA.—1½ mile, various sizes, switchboard cable, £282.—Siemens Bros. Dynamo Works, Ltd.
QUEENSLAND.—3,000 three-steel conductor cords, £200; 1,500 four-conductor cords, £72.—B.I. and Helsby Cables, Ltd.
75 C.B. table-pattern telephones, £180; 50 ditto, £139; and other telephone material.—J. Paton & Co.
WESTERN AUSTRALIA.—6,000 porcelain insulators, £90.—Commonwealth Art Pottery and Insulator Co. Pty., Ltd.; 32 cast-iron cable jointing boxes, type "C," £193.—A. M. Bryan.
N.S. WALES PUBLIC WORKS DEPARTMENT.—226 miles of galvanised iron telegraph wire, £11 6s. 3d. per ton.—R. Johnson, Clapham & Morris, Ltd.—*Tenders.*

COBRAM.—Electricity Supply:—
Suction gas engine and gas-producing plant, £747.—R. Hornsby & Sons.
Dynamos, switchboard, &c., £1,801.—Sutherland & Ashman.
Wire and cables, £435.—Stiffens & Nelle.—*Melbourne Age.*

Barnsley.—The Education Committee has accepted the tender of Mr. A. Brown, at £55, for installing electric light at Park Road Council School.

Bedford.—The T.C. has accepted the tender of Messrs. Gwynnes, Ltd., of Hammersmith, W., for electrically-driven pumps at the waterworks, at £3,190.

Belgium.—Five concerns submitted tenders last week to the Société Nationale des Chemins de Fer Vicinaux, of Brussels, for the overhead electrical equipment of the local electric railway between Ghent and Loochristry, the lowest being that of Messrs. Biske, Livron & Kalinowsky, of Liége.

Exeter.—The Tramways Committee has ordered four tramcars from Messrs. Dick, Kerr & Co., Ltd., for £2,832.

London.—L.C.C.—The Asylums Committee has accepted the following annual tenders:—

Electrical sundries.—Cox-Walkers, Ltd.; A. F. Goodwin & Co.; Edison and Swan U.E.L. Co., Ltd.; G.E. Co., Ltd.; Falk, Stadelmann & Co., Ltd.; G. Macfarlan & Co.; Veritys, Ltd.; W. White & Co.; Siemens Bros. Dynamo Works, Ltd.
Electric lamps.—Edison & Swan U.E.L. Co., Ltd.; G.E. Co., Ltd.; British Thomson-Houston Co., Ltd.; Siemens Bros. Dynamo Works, Ltd.

The Metropolitan Asylums Board has received the following tenders for the installation of a motor-generator at Queen Mary's Hospital:—

Napier Kimber, Ltd.	(accepted)	£169 10
Johnson & Phillips, Ltd.		189 0
F. M. Preckter & Co., Ltd.		190 0
Malcolm & Allan, Ltd.		210 0
Spagnoletti, Ltd.		210 0
C. H. Cathcart & Co.		235 0
Crompton & Co., Ltd.		258 0

The Fire Brigade Committee reports having received the undermentioned tenders for the installation of the electric light at the Belsize fire station:—

A. Newman, Ltd.	(recommended)	£155
G. E. Taylor & Co.		179
Tredegar & Co.		195
G. Weston & Sons, Ltd.		195
R. H. & J. Pearson, Ltd.		203
Buchanan & Curwen		260

The Committee recommends that the offer of the Tudor Accumulator Co., Ltd., be accepted to repair the batteries of an electrically-driven escape van, at £66.

The Highways Committee recommends that the work of additional windings to be placed on 17 motor-generators at tramway sub-stations, to enable the load of each to be increased to 400-KW. capacity, be carried out by Messrs. Newton Bros. as an extension of their contract, at £635.

BATTERSEA.—The Electricity Committee recommends the acceptance of the following annual tenders:—
Oils.—Prices, Ltd.
Turbine oil.—A. Duckham & Co.
Engine-room stores, packing, &c.—Pryke & Palmer.
Consumers' fire-boxes.—B.I. and Helsby Cables.
Box compound.—Dussek & Co.
Electrolytic meters.—Reason Manufacturing Co., Ltd.
Troughing, bridges, bitumen, &c.—Callender's Cable and Con. Co., Ltd.
Carbon lamps.—B.T.H. Co., Ltd.
Coals (13,000 tons Bankness Lanarkshire washed peas).—J. Hudson and Co., Ltd.

HACKNEY.—The Electricity Committee recommends the acceptance of the tender of Messrs. W. Cory & Son, Ltd., for six or 12 months, at the decision of the Council, for 15,000 tons Scotch washed nuts, at 15s. 3d. per ton; 15,000 tons Scotch washed pea nuts, at 14s. 3d. per ton; 15,000 tons Methley nuts, at 15s. 9d. per ton; 15,000 tons washed Barnsley bed, at 14s.; and 6,000 tons washed rough small, at 14s. per ton.

The Committee also recommends that 12 time-limit devices for the main direct-current switchboard be obtained from Mr. G. Ellison, of Birmingham, at £20.

ISLINGTON.—The B.C. contract for Chamberlain & Hookham A.C. meters has been placed with Messrs. Venner & Co.

Leicester.—The Borough Education Committee has accepted the tender of Messrs. Gent & Hurley for electricity-generating machinery and plant for Desford Industrial School, at £1,157.

Luton.—The Electricity and Tramways Committee has accepted the tender of Messrs. Crompton & Co., Ltd., at £328, for a balancer.

Mansfield.—The T.C. has accepted the tender of Messrs. Babcock & Wilcox at £1,910 for a boiler for the electricity works.

Mexborough.—The Electricity Committee has accepted the tender of Messrs. Galloways, Ltd., for eight new flue rings in connection with No. 3 boiler for £120, and that of the International Time Recording Co., Ltd., for the supply of an autograph recorder, at £20.

Rosyth.—An important contract has been placed with Messrs. Douglas & Grant, Ltd., Kirkcaldy, for the supply of machinery to H.M. Dockyard, Rosyth. The company has already carried out a large installation of somewhat similar machinery at H.M. Dockyard, Portsmouth, but the present contract is probably the largest single contract of the kind ever placed by the Admiralty with one firm. The special machinery ordered is all electrically-operated, and it is understood that Messrs. Douglas & Grant have secured the whole contract, including the electrical plant required in connection therewith. The Kirkcaldy company is also executing important orders for steam and electrically-driven pumping plant for H.M. Dockyards at Chatham and Pembroke respectively.

Southampton.—The Harbour Board has placed a contract for the annual supply of electrical stores with Messrs. Siemens Bros. Dynamo Works, Ltd.

South Africa.—The Johannesburg Municipality has been recommended to accept the tender of the British Westinghouse Co. for six 500-KW. rotary converters complete with switchgear, at £8,242. This was not the lowest tender, but the manager of the tramways and lighting department reported at length, showing that he recommended the firm named because (according to the *South African Mining Journal*) they were specialists in the manufacture of rotary converters, and had greater experience than any other firm in Great Britain.

Southend-on-Sea.—The T.C. has accepted the following tenders:—

Vandervell & Co.—Lighting six motor-'buses with the C.A.V. system, £292.
Brush Electrical Engineering Co., Ltd.—Three single open-deck tramcars (£2,811) and three electrically-driven coal wagons (£766 10s.) and equipment (£711).
Belliss & Morcom, Ltd.—Five Diesel oil engines for sub-stations, £14,150.

Swansea.—The B.C. has accepted the tender of Callender's Cable Co., at £12,998, for extra-high-pressure and low-pressure cables, conduits, &c., in connection with the proposed electrical extensions in the Uplands district.

Walthamstow.—The U.D.C. Lighting Committee recommends the acceptance of the tender of Messrs. E. Green and Son, Ltd., for replacing the economiser with pipes 2 ft. 6 in. longer, at £620, less 5 per cent.

Tenders by the following firms are recommended for acceptance for annual supplies of the electricity and tramways department:—

W. T. Henley's Co.—Cables, flex, compound for glands, rubber and other tape.
Liverpool Electric Cable Co.—India-rubber-covered wires.
Dussek Bitumen Co.—Box compound.
W. Geipel & Co.—Chatterton's compound.
B.I. & Helsby Cables, Ltd.—P. & B. paint.
General Electric Co., Ltd.—Soldering fluid, fuses, conduits, Sinclair insulators, &c.
J. H. Tucker & Co.—Switches.
Edison & Swan Co.—Ceiling roses, lampholders, opal shades, bell wire.
British Westinghouse Co.—Opal and iron shades and teak blocks, key switch-holders.
Wholesale Fittings Co., Ltd.—Fuse wire.
Pryke & Palmer.—Zinc rods, porous pots, dry cells, &c.
Chamberlain & Hookham.—Ordinary electric meters.
Electrical Co., Ltd.—Hour meters.
Sloan Electrical Co., Ltd.; Ship Carbons, Ltd.; and Siemens Bros. Dynamo Works, Ltd.—Carbons.
British Westinghouse; J. W. Rowlands & Co.; W. Wood & Co.; Anti-Attrition Metal Co., Ltd.; L. Andrew & Co.; Equipment and Engineering Co., Ltd; Imeson & Finch.—Car accessories.
Electrical and Mfg. Supplies; Cryselco Co., Ltd.; and the General Electric Co.—Lamps.
C. C. Wakefield; Stern Sonneborn Oil Co.; A. B. Gross & Co.; and Vacuum Oil Co.—Lubricating oil and grease.

Whitehaven.—The T.C. has accepted the tender of Messrs. Doulton & Co., Ltd., for earthenware troughs for electric cables for a year.

FORTHCOMING EVENTS.

North-East Coast Institution of Engineers and Shipbuilders.—Friday, March 27th. At 7.30 p.m. At Philosophical Society, Westgate Road, Newcastle-upon-Tyne. Paper on "High-Speed Bearings," by Mr. G. Stoney.

Physical Society of London.—Friday, March 27th. At 5 p.m. At Imperial College of Science. Papers on "A New Type of Thermogalvanometer," by Mr. F. W. Jordan; and "An Experiment with an Incandescent Lamp," by Mr. C. W. S. Crawley.

Royal Institution of Great Britain.—Friday, March 27th. At 9 p.m. At Albemarle Street, W. Paper on "Improvements in Long-Distance Telephony," by Prof. J. A. Fleming, F.R.S.

Saturday, March 28th. At 3 p.m. Paper on "Recent Discoveries in Physical Science," by Prof. Sir J. J. Thomson, F.R.S.

Faraday Society.—Friday, March 27th. At 4.30 p.m. At Burlington House. Discussion on "Optical Rotatory Power."

Finsbury Technical College Old Students' Association.—Friday, March 27th. At 8 p.m. At Waldorf Hotel, Aldwych, W.C. Eighth annual smoking concert.

South-Western Polytechnic Institute.—Friday, March 27th. At 8 p.m. At Manresa Road, S.W. Prize-giving, by Lord Chelmsford, G.C.M.G.

Manchester Association of Engineers.—Saturday, March 28th. At Grand Hotel, Aytoun Street. Annual General Meeting. Address on "The Training of Engineers," by Mr. J. C. Maxwell Garnett.

Royal Society of Arts.—Monday, March 30th. At 8 p.m. At John Street, Adelphi. Howard Lecture on "Surface Combustion," by Prof. W. A. Bone, F.R.S.

(Colonial Section).—Tuesday, March 31st. At 4.30 p.m. Paper on "The Oil Resources of the Empire," by Mr. D. F. Mollwo Perkin.

Institution of Civil Engineers.—Tuesday, March 31st. At 8 p.m. At Great George Street, S.W. Ordinary meeting. Papers on "Some Recent Developments in Commercial Motor-Vehicles," by Mr. T. Clarkson, and "Comparative Economics of Tramways and Railless Electric Traction," by Mr. T. Graham Gribble, to be further discussed.

(Students).—Friday, April 3rd. At 8 p.m. Students' Meeting.

Wireless Society of London.—Tuesday, March 31st. At 8 p.m. At the Institution of Electrical Engineers. Discussion on "Telephone Receivers," opened by Mr. L. J. Lucas.

Batti-Wallahs' Society.—Wednesday, April 1st. Informal Evening.

Institution of Civil Engineers of Ireland.—Wednesday, April 1st. At 8 p.m. At 35, Dawson Street. Ordinary Meeting.

Dynamicables.—Wednesday, April 1st. Anniversary Dinner.

Chemical Society.—Thursday, April 2nd. At 8.30 p.m. At Burlington House, W. Ordinary Meeting.

Institution of Electrical Engineers.—Thursday, April 2nd. At 8 p.m. At Victoria Embankment. Paper on "Electric Signalling on Railways," by Mr. H. G. Brown.

(Newcastle Students' Section).—Monday, March 30th. At 7.30 p.m. At Armstrong College. Paper on "Points on the Lay-out of Static Sub-stations," by Mr. W. Dixon.

(Manchester Students' Section).—Tuesday, March 31st. At 7.30 p.m. At Municipal School of Technology. Annual General Meeting.

(Students' Section).—Wednesday, April 1st. At 7.45 p.m. Paper on "Automatic Pressure Regulators," by Messrs. A. Arnold and E. L. M. Emtage.

(Newcastle Local Section).—Friday, April 3rd. At 7 p.m. At Hugh Bell School, Middlesbrough. Address on "Ozone," by Mr. E. L. Joseph.

Royal Institution of Great Britain.—Friday, April 3rd. At 9 p.m. At Albemarle Street, W. Paper on "Further Researches on Positive Rays," by Prof. Sir J. J. Thomson, F.R.S.

Saturday, April 4th. At 3 p.m. Paper on "Recent Discoveries in Physical Science," by Prof. Sir J. J. Thomson, F.R.S.

Association of Engineers-in-Charge.—Saturday, April 4th. Bohemian Concert.

North of England Institute of Mining and Mechanical Engineers.—Saturday, April 4th. At 2 p.m. At Newcastle-upon-Tyne. General Meeting.

Salford Technical and Engineering Society.—Saturday, April 4th. At 7 p.m. At Royal Technical Institute, Peel Park. Paper on "Mechanical Ventilation," by Mr. M. Sutcliffe.

THE ELECTRICAL ENGINEERS
(LONDON DIVISION).

Commanding Officer—LIEUT.-COL. H. M. LEAF.

The following orders have been issued for the current week:—

Monday, March 30th.—"A" Company. Technical instruction, 7 to 10 p.m. Miniature range practice, 7 to 9 p.m.

Tuesday, March 31st.—"B" Company. Technical instruction, 7 to 10 p.m. Miniature range practice, 7 to 9 p.m.

Wednesday, April 1st.—Recruits only. Recruit instruction, 7 to 10 p.m. Rating examination for all Companies, 7 to 10 p.m.

Thursday, April 2nd.—"C" Company. Technical instruction, 7 to 10 p.m. Miniature range practice, 7 to 9 p.m.

Friday, April 3rd.—"D" Company. Technical instruction, 7 to 10 p.m. Miniature range practice, 7 to 9 p.m.

Saturday, April 4th.—Headquarters will be opened for regimental business only from 10 a.m. till 12 noon.

The Easter Camp will be held at Cliffe Fort, near Gravesend, commencing on April 8th, for 15 days. Parade at headquarters at 11 a.m., April 9th, for the issue of arms and equipment. Members who wish to attend this camp should send in their camp cards without delay.

(Signed) F. R. HOLT-WHITE, Capt. R.E., Adjutant.
For Officer commanding L.E.E.

NOTES.

Good Friday Week.—Owing to April 10th being Good Friday, our issue for that day will appear on Wednesday, April 8th, and all editorial and advertisement matter will require to be in our hands two days earlier than usual.

A New Society.—The Igranic Engineering Society has recently been formed for members of the staff of the Igranic Electric Co., Ltd., of London and Bedford. The president of the Society is Mr. G. A. Mower, and the chairman Mr. A. H. Curtis. On Wednesday evening, 18th inst., a paper was read by Mr. F. Heaton on the subject of "Bridge Control," dealing fully with the electrical operating and signalling equipment of Scherzer rolling-lift bridges, transporter bridges, and swing bridges. The lecture was fully illustrated by lantern slides of a large number of typical bridges and controlling and signalling equipments, and was followed by a discussion. The full programme of the Society's meetings for the present session is as follows:—

February 4th.—"High-speed Elevator Control," by Mr. A. H. Curtis.
February 18th.—"Printing Machinery and its Control," by Mr. A. H. Mackley.
March 4th.—"Board of Trade and Home Office Regulations," by Mr. S. E. Hall.
March 18th.—"Bridge Control," by Mr. F. Heaton.
April 1st.—"Electric Control of Laundry Machinery," by Mr. F. N. Pickett.
April 15th.—"Alternating-current Control Apparatus," by Mr. F. Oglesby; "Automatic Temperature Control," by Mr. H. H. Rapley.
April 29th.—"Lifting Magnets," by Mr. S. R. Wright.

The Utilisation of Solar Energy.—Mr. A. S. E. Ackermann will shortly read a paper before the Society of Engineers (Incorporated) on "The Utilisation of Solar Energy," embodying the results of his 48 trials of the Shuman plant for raising steam and generating power from the sun's heat. The plant tested has cost some £30,000, the investigations cover nearly four years, and though many experiments with sun power have been made during the last 50 years, this is the first paper of its kind. The meeting is to be held at the Institution of Electrical Engineers on Monday, April 6th, at 7.30 p.m.

In view of the satisfactory results obtained from the plant at Meadi, near Cairo, the Egyptian Government has placed an order with the makers for a similar but larger plant for irrigation work in the Sudan. The Cairo plant has an output of 50 B.H.P., and the heating surface covers an area of about 1 acre.

Electrical Trades Benevolent Institution.—On Wednesday the annual festival of the Institution was held at the Trocadero, and there was a record attendance. Mr. Hugo Hirst presided, and was supported by Sir David Salomons (President), Mr. C. H. Wordingham (Vice-President), Mr. Justus Eck (Chairman of Committee), and Mr. Godfrey Isaacs. A report will appear in our next issue, but in the meantime we wish to congratulate Mr. Hirst on the splendid success which he has achieved, the record sum of £2,762 having been subscribed in connection with the dinner. This is more than three times last year's record, which itself was double the previous one.

Smoke Abatement.—The Smoke Abatement Bill, promoted by Lord Newton, which has reached the second reading in the House of Lords, makes it an offence for anyone to use a furnace not constructed to burn its own smoke, or to use such a furnace in a negligent manner, and omits the reference to "black smoke." The L.G.B. will, however, have power to exempt any particular works in which it is not reasonably practicable to comply with the requirements of the Bill.

Electrical Accidents in Germany.—According to a recent return, 251 electrical accidents occurred in Germany last year, causing the death of 147 persons and slight injuries to 10 others, while 71 were badly injured. Fourteen of the accidents occurred during repairs to electric mains, 38 were due to short-circuits, 6 to falling of wires, 126 to cable failures, 23 to carelessness, and 30 cases are attributed to unknown causes.

Appointments Vacant.—Storekeeper for Hampstead Borough Electricity Department (£2 10s. and bonus); junior assistant engineers (young men just leaving college, or apprentices out of their time), for Yorkshire Electric Power Co.; assistant constructional engineer, for Birmingham Electric Supply Department (£250); mains assistant, D.C. three-wire system, for Brighouse (25s.). Particulars are given in our advertisement pages.

The Patents Act.—A Bill to amend the Act of 1907 has been introduced by the Board of Trade. It amends Sec. 91, so as to extend the rights of priority to the legal representatives or assignees of an applicant for protection. As this proposal follows upon an international convention held in 1911, it appears to be somewhat belated.

Electric Treatment at a Lancashire Infirmary.—The relatives of the late Alderman T. R. Greenough, J.P., have decided to give to the Leigh Infirmary a new building equipped with the latest and best apparatus for radiographic treatment. No institution in the country will have a better equipment. In addition, the new building will contain everything requisite for the electric treatment of disease.

Staff Dinner.—The annual dinner of the staff of the Osram and Robertson Electric Lamp Works was held at the Clarendon Restaurant, Hammersmith, on Monday, March 23rd. Mr. C. Wilson occupied the chair, and among the visitors present were Mr. Hugo Hirst, Mr. Forman (Mayor of Hammersmith), numerous familiar G.E.C. friends, and a very liberal sprinkling of Borough Councillors. The staff and visitors present totalled about 125, visitors being in the majority. Following an excellent repast, the chairman gave the usual loyal toasts, and then proposed the "Allied Firms." Mr. Wilson laid special emphasis on the directors' keen interest in the welfare of their staff and workpeople. The advantages of the staff club—to the foundation of which the directors had contributed so handsomely—were appreciated daily by every member, and as regarded the workpeople, the collapse of their sick fund, due to unfortunate indirect effects of the Insurance Act, had been repaired by the generosity of the directors in placing a special fund at his disposal to be applied to the benefit of invalid workers. He particularly welcomed Mr. Hirst, to whom so much of the firms' prosperity was due. From the commercial standpoint, the policy of the allied firms had been successful in conception by the directors, and in application by the staff. So long as the combination continued to work with its present energy and harmony, the success of the allied firms was ensured. In responding to this toast, Mr. Hirst expressed his keen pleasure at being present, and dwelt on the national importance which the work of the allied firms had assumed, and on the very considerable material benefits which had thereby accrued to the borough of Hammersmith during the last 20 years. The health of the "Visitors and the Press" was proposed by Mr. F. P. Driver. In replying, the mayor expressed the pleasure which it gave him and his colleagues to be present that evening, and endorsed Mr. Hirst's remarks concerning the value of the Osram and Robertson Works to the borough. In every respect the interests of the borough and of the works were linked together, the activities of the latter were much appreciated, and everything had been, and would be, done to facilitate the development of these activities. He had great pleasure in wishing the allied firms every success. Mr. J. Fletcher expressed forcibly his reluctance to speak at length, but thanked the staff very heartily for the hospitality extended to him and his colleagues. Mr. Sydney Rentell replied suitably on behalf of the Press. Later in the evening Mr. P. Pring proposed the health of the chairman. This toast, together with Mr. Wilson's reply, was received vociferously, and demonstrated beyond doubt the esteem in which the genial works manager is held. An excellent musical programme was arranged, reliance being placed, as in previous years, almost entirely upon staff talent.

The London Electrical Trade Dispute.—Several meetings have lately been held in London during the last 10 days, relating to the London electric wiremen's dispute. A Committee of the Masters met a Committee of the Men on 19th inst., to discuss the demands respecting pay and conditions. Afterwards Mr. Kinniburgh, organising secretary of the E.T.U., said that on their main demand for 11d. an hour, the employers would not give way. On the 20th the workers held a meeting at the Caxton Hall at which they resolved that unless the masters gave a favourable answer by yesterday (Thursday), they would cease work. A mass meeting for to-night is mentioned in one Press report; the men are then expected to give a final decision on the employers' terms before declaring a strike. The men have passed a resolution declaring that they will have no form of disability clause in their rules. The Conference between the London Master Builders' Association and the building trade workers' organisation was only able to take place last week by the exclusion of the E.T.U. and other Unions not involved in the building trades dispute.

[What is the matter with the *Daily Telegraph* and the *Daily News*, that in a threatened strike of wiremen they see a prospect of London being without its supply of electricity?]

Income-Tax Assessment.—A note appeared in several technical journals recently to the effect that a new method of dealing with income-tax assessment on electricity undertakings had been "discovered" in St. Pancras, by which a considerable saving on this item of expenditure had been effected. We believe, however, that this "discovery" is based upon some long negotiations between Mr. Jennings (secretary and accountant of the Marylebone electric supply) and the Inland Revenue authorities three years ago. Mr. Jennings's memorandum on this matter has been circulated widely, and a large number of municipal electrical undertakings have taken advantage of the decision. The St. Pancras treasurer's report is merely one based on Mr. Jennings's report of 1911.

Boy's Damage on N.-E.R.—At the Tynemouth Police Court on March 24th, an 11-year old boy was charged with having damaged rails on the North-Eastern Railway. The evidence was that on February 12th a portion of the line was discovered to be on fire near Cullercoats Station. The flames were extinguished by sand, and then it was found that a piece of metal had been placed across the live rail and the running rail, creating a short circuit. The running rail was burned completely through, and the piece of metal had been welded to the conductor rail. The cost of repairing the damage was £1 8s. 6d. The boy's father was ordered to pay a fine of 5s. and costs, as well as the damage.

Inquiries.—Makers of Wilk's patent transparent bell-pushes, "Securitas" rubber solution, "Shawtype" lightning arresters, and small metal stampings are asked for.

Institution and Lecture Notes.—Association of Engineers-in-Charge.—On Saturday last the annual dinner of the Association took place at the Holborn Restaurant; the president, Dr. R. T. Glazebrook, occupied the chair, and there was a large attendance of members and guests, the company numbering over 300.

After the loyal toasts, Mr. B. A. Raworth proposed that of "Science, Practice and Technology"; he referred to the trials of the engineer-in-charge, who often had to run machinery designed by another engineer who never had had to run it himself, and pointed out that a machine was not scientifically designed unless it worked properly in practice. The engineer-in-charge had to keep the machines going for the sake of those whose comfort and well-being depended upon its operation, and therefore to aim at extremely high efficiency at the expense of reliability was neither scientific nor practical. Efficiency must be given a very broad definition, in which cost was an essential factor. They could not make much progress without the aid of science; but many invaluable discoveries had lain dormant for years for want of a practical man to apply them. Responding, Sir Alfred Keogh said that this country was very slow to take advantage of advances in science. The great college of which he was the head was established with the object of bringing science and industry together, and of giving young men a better training for practical work; a guiding principle which they had adopted was that of seeking the advice of great leaders of industry in preparing their schemes.

Mr. A. E. Penn (hon. secretary) proposed "Kindred Institutions and our Guests," to which Mr. Leslie T. Robertson responded, pointing out that all the kindred institutions were combined in their representation on the Engineering Standards Committee (of which he is the secretary). He said it was important that the junior members of the profession should have the opportunity of joining in technical discussions and exchanging views, and the Association had done good work in educating its members to fill positions of trust. Sir Thomas Pile also replied, ascribing the success of the Association largely to the ability of its secretaries.

Sir Boverton Redwood, proposing "The Association," gave some amusing reminiscences of his early experiences in connection with engineering. He said that the Association was making satisfactory progress, though its numerical strength was limited by the strict examination of the credentials of candidates for admission. Unfortunately, unqualified men were often appointed as engineers-in-charge, and in a recent advertisement, the same salary was offered by a certain board of guardians for an engineer of wide knowledge and experience, as for a cook. How could the right sort of man be obtained under such conditions? A system of certification was needed, and there was work for the Association to do in arousing the authorities to a sense of their duty. Dr. Glazebrook, in responding, said that the Association had done good work in its various functions, and deserved to have its value better known. Remarking that all such institutions started in a small way, he traced the development of the Royal Society from its birth, and concluded by offering cordial thanks to the officers of the Association, by whom its affairs were so admirably conducted—especially Mr. Neale (chairman), Mr. Ball and Mr. Penn (hon. secretary).

During the evening a programme of music was performed, under the direction of Mr. George Hardy.

Association of Electrical Station Engineers.—An open general meeting of the Bradford Section was held at Dewsbury on March 17th. This meeting being the first one held at Dewsbury, a statement was made outlining the aims and objects of the Association, and an appeal was made for new members. As is usual at all open meetings of the Association, the non-members present were somewhat critical, the criticisms on this occasion being based on unfounded statements which appeared in the provincial daily Press after the London Electrical Masters' meeting in London, in January. The meeting was of the opinion that the executive of the A.E.S.E. should make a definite statement of the policy of the Association at the earliest possible moment, as being the only way to allay the fears of those prospective members who were still in the "wait-and-see" camp.

A meeting of the Midland Branch was held at Birmingham on March 17th. The usual branch business was transacted, and a small committee was formed to arrange "visits" for the summer months, with a view to getting more into touch with private plant engineers.

A meeting was held recently at Manchester, and a paper was read on "Electric Driving in Cotton Mills." The advantages and disadvantages of electric and steam driving were considered, also the relative merits of individual driving and group driving of spinning machinery. The writer of the paper, Mr. W. G. Stokes, expressed himself as being in favour of group driving. An interesting discussion followed.

Institution of Electrical Engineers.—At the meeting of the Birmingham Local Section on Wednesday last a paper was read by Mr. W. Fennell, M.I.E.E., on "Electric Lighting of Cottages." The discussion was closed.

Association of Mining Electrical Engineers.—At a meeting of the West of Scotland Branch on Friday last, Mr. Charles E. Hart, Glasgow, read an interesting paper on "Rock Drills." Referring to electric drills, the author said that there were some purely electric drills in use, but they were used entirely in soft rock, coal and shale, and the motion was rotary. The Marvin Sandycroft drill had found a limited field for employment in some quarries, and open-air work, but he did not think it could compete with the compressed-air drill. To the Ingersoll Rand Co. must be given the credit of getting the nearest approach to an electric drill in their electric air drill. The astonishing feature about it was the great reduction it afforded in power, as a 5-H.P. motor drove an electric air drill equivalent in capacity to a 3¼-in. diameter compressed-air percussive rock drill, which took 20 H.P. and sometimes even more. The fact that the air was used over and over again, and not exhausted, accounted for the low power required, which was the chief advantage of the machine.

On the invitation of the Pumpherston Oil Co., the members of the East of Scotland Branch are to visit the Breich Colliery, Breich, to-morrow, to inspect the electrical winder which is in operation there, and for which highly successful results are claimed.

Nottingham Society of Engineers.—On March 11th, Mr. W. C. Mountain read a paper on "The Utilisation of Exhaust Steam for Collieries, Iron Works, &c., and the Cost of the Electric Current Generated."

Physical Society of London.—On March 13th, a paper entitled "Time Measurements of Magnetic Disturbances and their Interpretation" was read by Dr. C. Chree. A paper, entitled "The Asymmetric Distribution of the Secondary Electronic Radiation Produced by X-Radiation," by Mr. A. J. Philpot, was taken as read.

Parliamentary.—Glasgow Corporation Bill.—Amongst the petitions which have been deposited in the Private Bill Office against the Glasgow Corporation Bill (water, tramways, &c.) are those of the Airdrie and Coatbridge Tramway Co., the Greenock and Port Glasgow Tramways Co., the Coatbridge and Airdrie Electric Supply Co., and the Lanarkshire Tramways Co.

Reading Corporation Bill.—The Select Committee of the House of Lords before which the Reading Corporation Bill was down for consideration, has reported that all opposition has been withdrawn, and therefore it had been referred to the Unopposed Bill Committee. The Bill provides for additional tramways in the borough and also for the running of trolley vehicles.

Preston Corporation Bill.—The Preston Corporation Bill came before Mr. Middlebrook's Select Committee of the House of Commons for several days last week. The main portion of the Bill dealt with the improvement of the Ribble navigation. Power was also sought to borrow £26,000 for tramway extensions, but there was no opposition to this portion. Evidence was given by Mr. Simpson, the tramways engineer. The Committee sanctioned all the clauses with the exception of one empowering the Corporation to enter into agreements to supply electrical energy to trolley vehicle systems in adjacent districts.

Protection or Tyranny?—The following letter came to hand after our "Correspondence" columns were closed:—"The reference to this correspondence in your last issue by the chairman of the Council is typically B.E.A.M.A. To pass off the whole matter by such a supercilious reference is no answer to the case. The recent correspondence from the Electric Construction Co. more than justifies what I have said.

"However, I have made my protest and, as far as I am concerned, the matter is at an end, but it will be found on record when the day, which is fast approaching, comes that the buyer is in subjection to the seller, and the former finds himself in the same position as the Government to-day are, in their purchasing of 'Armour plates.'

"F. W. Purse, *City Electrical Engineer.*

"Carlisle, March 24th. 1914."

Labour Dispute at Glass Works.—Early on Saturday morning a settlement of the dispute at the Lemington Glass Works, near Newcastle-on-Tyne, was reached, whereby the bulb-blowers, numbering about 80 men, who came out on March 12th, thereby laying between 300 and 400 employés of the works idle, were to resume work on Monday, the 23rd inst. The dispute arose owing to the introduction of machinery in the making of electrical lamp bulbs, and we understand a settlement has been effected on the basis of the men giving the machines a fair trial, and the employers making up any deficiency should the men prove to be unable to make a certain average wage.

The Electro-Harmonic Society.—The last smoking concert of the season, held on Friday last, was one of the best of the year, in spite of the regrettable fact that two of the principal artistes were unfortunately prevented by sudden illness from taking part in the entertainment. Excellent substitutes were found at short notice in Messrs. Alec Chentreus, the Anglo-French comedian, and Jan Linden ('cello), an artiste of the first rank, and the company as a whole was above the average. Mr. Robert Howe, as a newcomer to the Electro-Harmonic, deserves special mention, as well as Mr. Anderson Nicol and Mr. Robert Radford; and Prof. Anders performed some remarkable and inexplicable feats with cards and handkerchiefs. The audience was enthusiastic, almost all the items being encored.

Labour Disputes.—A Manchester paper states that after being out on strike for 15 weeks 3,000 engineers at Bolton resumed work on Monday.

Press reports also show that the Sheffield electrical trade dispute is at an end, the men accepting the masters' offers of 2s. advance on April 3rd, and 1s. six months later, with 6 per cent. advance on piecework rates and a three-year agreement.

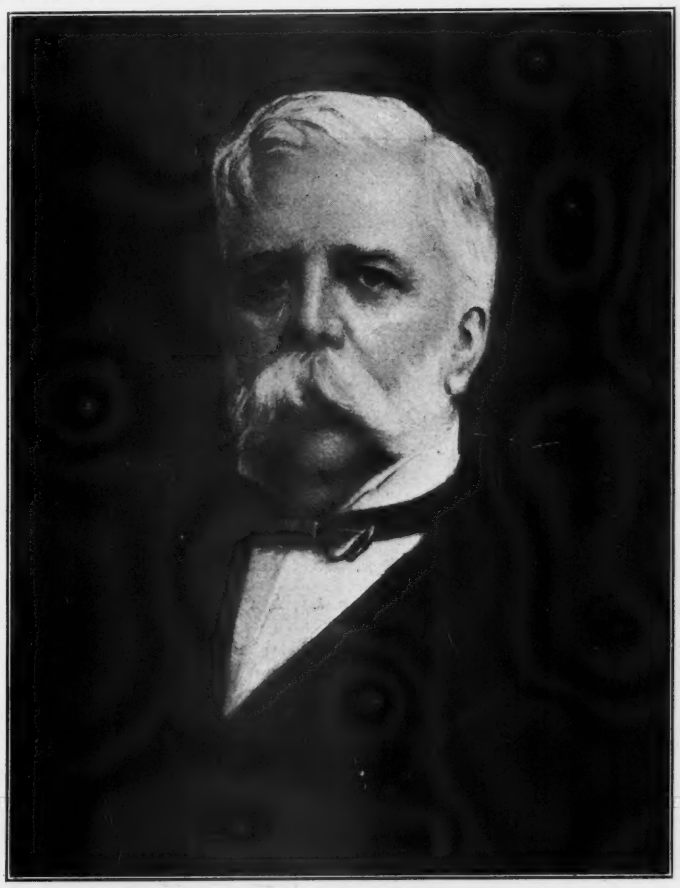
British Science Guild.—The *Times* announces that Sir William Mather will preside at the annual dinner of the British Science Guild at the Trocadero Restaurant on May 22nd.

Annual Social.—The Bermondsey Electricity Department held its fourth annual social recently at the Spa Road Town Hall. Some 200 ladies and gentlemen were present, being received by the Mayor and Mayoress.

(*Continued on page 542.*)

THE LATE MR. GEORGE WESTINGHOUSE.

The late George Westinghouse was a man of striking presence and strong personality. Perhaps there was no other man in American or British electrical engineering affairs to whom fell so much influence and distinction coupled with wealth and honours. Some of the articles that have appeared since his death seem to us to needlessly strive after contrasting the "comparatively humble circumstances" in which he began life, with the position of wealth and fame with which his career has closed. It must not be imagined from such a comparison that he was either a newspaper boy or a crossing-sweeper. As a matter of fact, he was the son of a manufacturer of agricultural machinery, was educated at public high-schools and college, came of an engineering stock and was reared in an engineering atmosphere, and he had four brothers—a circumstance preventing pampering and luxury, and aiding the development of character. He was at the age of ten when his father opened the agricultural machinery works; as a boy, machinery provided him with his chief amusement, and his early years were spent among his father's business affairs. We suppose, regarding these conditions purely from the dollar standpoint, and remembering that George Westinghouse has died worth many millions, they were comparatively humble, but they were ideal surroundings for a lad possessed of inventive ingenuity. He was not a mere visionary or impossible contriver as an inventor; his surroundings and subsequent experience and training gave him a remarkable grasp of and ability in financial and commercial affairs—qualities so often lacking in inventors to whom success never comes. The importance of such qualities in controlling the vast industrial and other organisations that were established in consequence of his discoveries is readily recognised.



The Late Mr. George Westinghouse.

Mr. Westinghouse was born at Central Bridge, New York, in October, 1846; his family was of German extraction. Ten years later came the removal to Schenectady to start the agricultural works already mentioned. At the age of fifteen George had invented and built a rotary engine; in the next year he served in the New York National Guard, and later in the New York Cavalry, and in 1864 and 1865 he served as third assistant-engineer in the United States Navy. When nineteen he produced a device for replacing railway cars on the track. It was, however, at the age of twenty-two that he made the invention which formed the basis of his other enterprises—viz., the Westinghouse air-brake, the first patent for which was granted in April, 1869. Mr. Westinghouse came to England in 1871 for the purpose of introducing the air-brake, which revolutionised the methods of railway working, and in the process of meeting new conditions the automatic feature was introduced. The patent for the quick-action brake was granted in 1886.

In 1863, he turned his attention to the application of pneumatic control to the operation of railway signals and switches, and developed and patented the system now manufactured by the Union Switch and Signal Co.

He became interested in the manufacture of lamps and electric lighting apparatus in 1886, the Westinghouse Electric Co. being formed for this purpose. The United States Electric Lighting Co. and the Consolidated Electric Light Co. were absorbed by this company, the whole being reorganised and consolidated in 1891 into the Westinghouse Electric and Manufacturing Co. at East Pittsburg. He was one of the first to perceive the limits of the direct-current system, and in 1885 acquired the American rights to the inventions of Messrs. Gaulard and Gibbs in connection with alternating currents, which he introduced as a system of distribution, in spite of the strongest opposition and the opinion of eminent men such as Lord Kelvin as to its commercial value. He gathered about him William Stanley, Nikola Tesla, O. B. Shallenberger and others, who contributed not a little to this development. He backed Mr. Tesla with both manufacturing and financial assistance in the development of the induction motor, while his foresight in perceiving the advantages of the alternating transformer for varying pressure has made possible the transmission of energy over long distances and its utilisation at remote points.

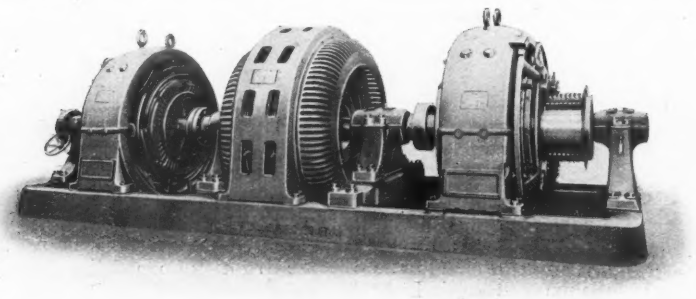
Allied to this, and his previous connection with railway work, was his great interest in the problem of railway electrification—in particular of the development of the possibilities of the single-phase motor for traction work, and his keen appreciation of the essential conditions of railway working.

His interest in electric lighting is instanced by the formation of companies to manufacture the Nernst lamp, the Cooper-Hewitt mercury vapour lamp, the Bremer arc lamp, and the carbon and metal-filament incandescent lamps.

Most important, also, has been the work done by Mr. Westinghouse in the development of the steam turbine, and still more recently in the solution of the problem of its application to marine propulsion.

Mr. Westinghouse was given the honorary degree of Doctor of Philosophy by the Union College in 1890. In 1896 the Koniglische Technische Hochschule, of Berlin, bestowed upon him the degree of Doctor of Engineering; he was also decorated with the Legion of Honour of France, the Royal Crown of Italy, and Leopold of Belgium. He

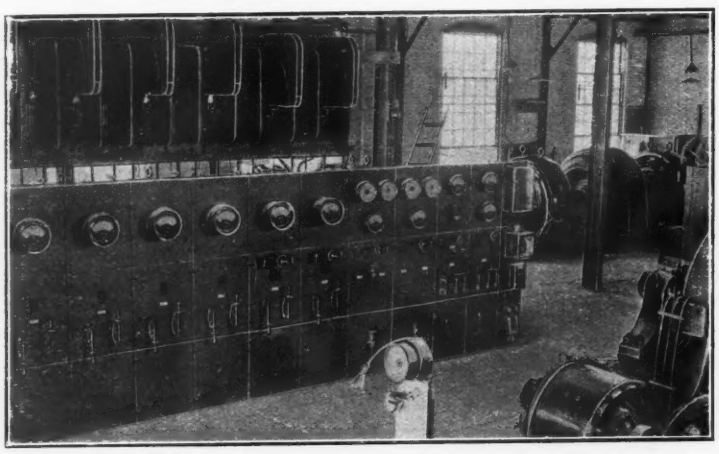
was the second recipient of the John Fitz Medal, and was honorary member of several American Associations. In December last he received the decoration of



1,000-kw., 2,400-volt d.c. Motor-Generator Set, as Installed in Sub-stations, Butte, Anaconda and Pacific Railway.

which he was, perhaps, prouder than any other, viz., the Drashof Medal, awarded for having obtained the most important results in engineering during the year. Mr. Westinghouse was the first American to receive this tribute, which is conferred annually in memory of Frantz Drashof by the engineering profession in Germany.

At the time of his death, Mr. George Westinghouse was director of 18 Westinghouse undertakings (of 15 of which he was president) having an aggregate capital of over one hundred million dollars, the largest of which are the Westinghouse Air Brake Co., the Westinghouse Machine Co., and the Union Switch and Signal Co., employing in and around Pittsburg alone some 50,000 persons. Only one of the five brothers is now living, namely, Mr. Herman H. Westinghouse, who was associated with the deceased gentleman in most of his enterprises.



2,400-volt d.c. Switchboard, &c., Anaconda Sub Station.

THE 2,400-VOLT DIRECT-CURRENT ELECTRIFICATION OF THE BUTTE, ANACONDA AND PACIFIC RAILWAY, U.S.A.

The Butte, Anaconda and Pacific Railway is one of the most remarkable examples of steam road electrification in the States. Besides being the first 2,400-volt direct-current road, it is also credited with being the first steam road operating both freight and passenger schedules, to electrify its lines purely for reasons of economy.

The equipment was supplied by the General Electric Co., U.S.A., and the first electric locomotives were put into service on May 28th, 1913, hauling ore cars between the East Anaconda yards and the smelter. During the first seven months of service, they ran approximately 201,000 miles, and hauled about 2,365,000 tons of ore.

The change from steam to electric haulage was made without any change in the personnel of the train crews and without any delays or alterations in the schedule. The engineers, without exception, have expressed themselves as being greatly pleased with the easy operation of the locomotives.

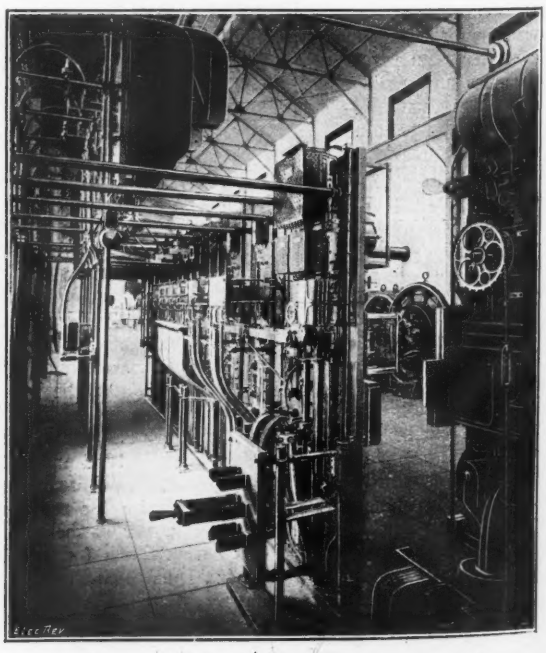
The electrified lines of this system extend from the Butte Hill yard to the smelter, a distance of 32 miles. There are numerous sidings, yards, and smelter tracks that have been equipped with overhead trolley, making a total of about 95 miles on a single track basis.

The Butte, Anaconda and Pacific Railway is essentially an ore hauling road, the freight traffic from this source originating at the copper mines located near the top of Butte Hill. From the mines the ore trains are lowered down the mountain, a distance of 4½ miles to the Rocker yards located a few miles west of the city of Butte. At this point new main line trains are made up for transportation to the smelters at Anaconda. The main line division extends through a rough mountainous country, a distance of about 20 miles, with grades as high as 0·3 per cent.

At East Anaconda the main line trains are broken up and hauled up Smelter Hill to the stock bins, where each car is run over the scales and weighed. The shifting of cars in connection with weighing and subsequent delivery to the contractors is done by single locomotives.

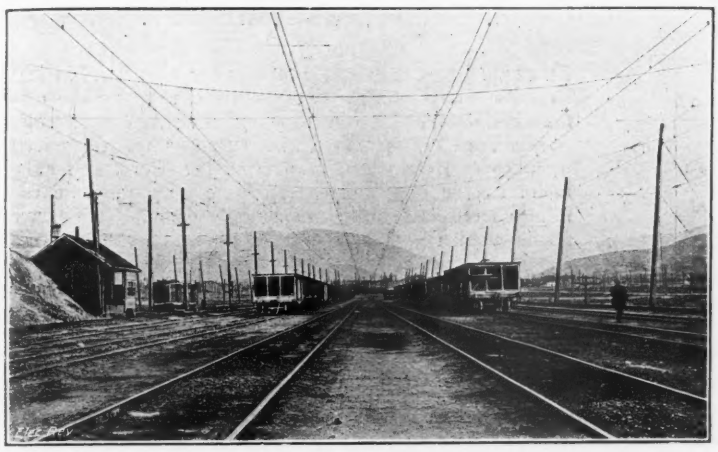
The east-bound traffic consists in returning empty cars to the mines and the transportation of copper ingot to the Butte yards, where it is shipped over other roads to refineries.

Between the cities of Butte and Anaconda, which are located at the ends of the electrified portion of the system, there is considerable local traffic both passenger and freight. The city of Butte and vicinity has a population of about 65,000, and Anaconda, about 10,000. At Butte, the Butte, Anaconda and Pacific connects with the Great Northern Railway, the Northern Pacific and the Chicago, Milwaukee



Rear View of d.c. Switchgear, Butte Sub-station.

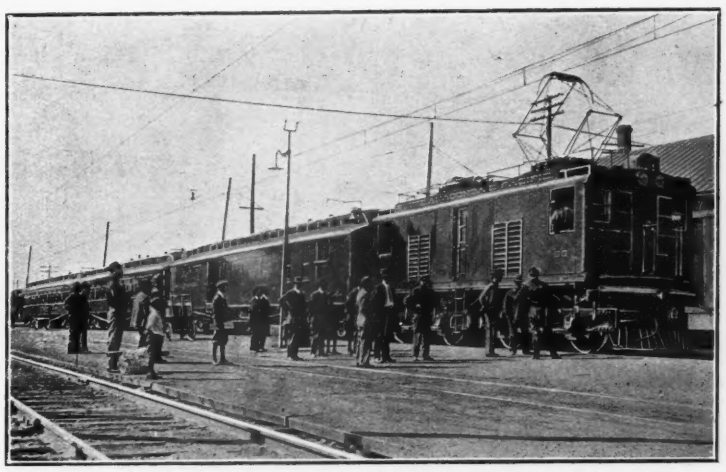
and St. Paul Railroad; and at Silver Bow, about six miles from the city, connection is made with the Oregon Short Line.



Eight-track Tangent in the Butte Yards.

For a distance of 16 miles the Butte, Anaconda and Pacific Railway is paralleled by the trans-continental lines of the Northern Pacific and the Chicago, Milwaukee and St. Paul. The last-named company has already contracted for power for the operation of electric trains from Harlowton, Montana, to Avery, Idaho, a distance of 440 miles.

The maximum curvature on the system (20°, 285 ft. radius) occurs on the Butte Hill line. On this part of the road there is an average curvature of 6° to 10°. The locomotives are designed with sufficient flexibility to take a curve of 31° (180 ft. radius) at slow speed.



Electric Locomotive and Train at Butte Station.

The freight traffic consists largely of copper ore, and amounts to more than 5,000,000 tons a year. This material is handled in steel cars, weighing about 18 tons, and having a capacity of 50 tons each. Trains of 30 loaded cars, weighing 2,000 tons, are made up at the Butte Hill yards, and hauled by two-unit locomotives to the Rocker yards, where 4,000-ton trains are made up for the main line. At the East Anaconda yards the trains are again broken up, and 1,400-ton trains are sent up Smelter Hill to the ore bins. All of the shifting and "spotting cars," at the smelters and in the sorting yards, is done by single locomotive units. The customary train make-up for both east and west-bound traffic is given in the table on the next page.

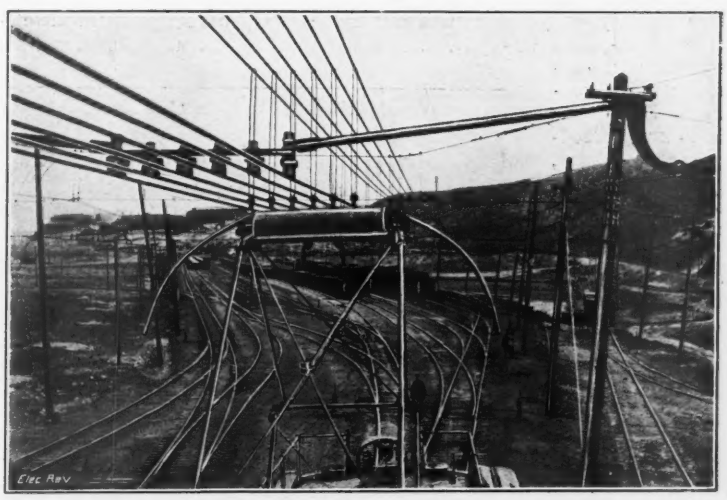
Eight passenger trains per day are operated between Butte and Anaconda, four in each direction. The main line trains were first hauled by electric locomotives on October 1st, 1913, and promptly demonstrated their ability to make better time than was possible with steam engines. Single locomotives are used, hauling trains of from three to five passenger and baggage cars.

Energy for the operation of electric trains is purchased from the Great Falls Power Co. The generating plant is located at Great Falls, Mont., on the Missouri River, and has a nominal rated capacity of 21,000 kw., generating 6,600 volts, three-phase, at a frequency of 60 cycles. The power is stepped up to 102,000 volts for transmission to the transformer sub-station at Butte, a distance of 130 miles, over two separate parallel lines constructed on the same right-of-way. An extension of the system transmits power at 60,000 volts to a second transformer station at Anaconda, 26 miles farther on.

The Butte station forms the centre of the extensive power system operated by the Montana Power Co. Besides the Great Falls 102,000-volt transmission lines, there are several 60,000-volt transmissions terminating at this point, which form a part of the Montana Power Co.'s system. These lines bring in power from the Hauser Lake, Canyon Ferry, Madison and Big Hole plants. At the Butte sub-station the pressure is stepped down to 2,400 volts and all the lines are tied in on the 2,400-volt A.C. bus-bars. Ample protection is, therefore, afforded from interruption of service.

It is an interesting fact that the railway load was taken on without any increase in the high-tension transmission facilities. It is estimated that the additional load from this source is approximately 20 per cent. of the railway, industrial and lighting load furnished by the street railways, mines, and smelter at Butte and Anaconda.

The two existing sub-stations at Butte and Anaconda were used to house the 2,400-volt motor-generator sets required for operating the electric trains, so that no additional buildings were constructed for this purpose. Power



Pantograph Engaging Six Trolley Wires.

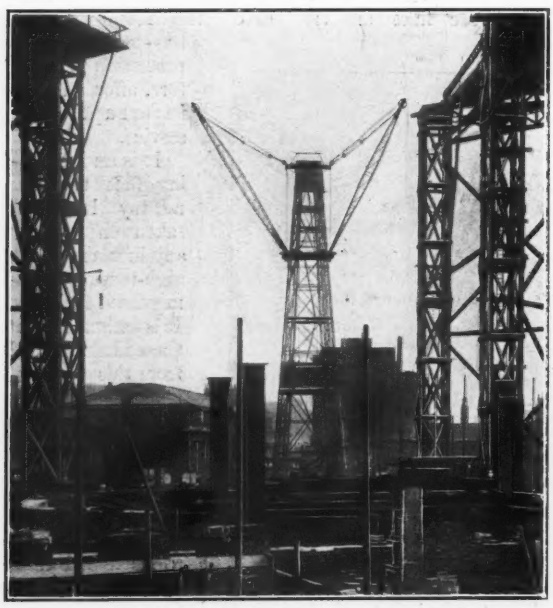
is furnished by two 1,000-KW. 3-unit motor-generator sets in each sub-station, taking power from the 2,400-volt

CONDENSED INFORMATION OF FREIGHT MOVEMENT.

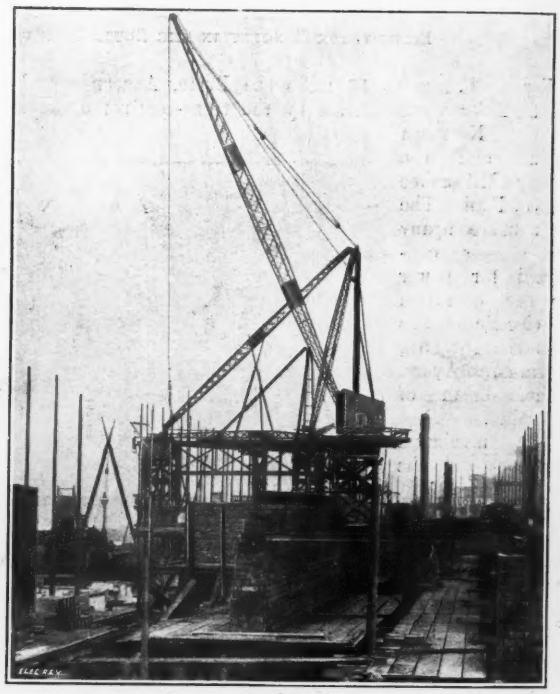
	West Bound.			East Bound.		
	Butte Hill line.	Main line.	Smelter Hill.	Smelter Hill.	Main line.	Butte Hill line.
Trailing load in tons	2,000	4,000	1,400	1,000	1,260	650
Number of cars ...	30	60	20	55	70	35
No. of 80-ton locomotives per train	2	2	2	2	2	2
Approximate grade against load ...	2·5 %	0·3 %	1·1 %	1·1 %	1 %	2·5 %
Approximate speed on level tangent track, M.P.H. ...	—	21	—	—	25	—
Approximate speed on max. grade...	12	16	16	20	16	16
Average trolley voltage	2,200	2,200	2,200	2,200	2,200	2,200
Length of run in miles	4·6	20·1	7	7	20·1	4·6

A.C. bus-bars. These units operate continuously 24 hours per day, seven days of the week, to supply the necessary current for train operation; each consists of a three-phase, 60-cycle, 1,450-K.V.A., 720-R.P.M. synchronous motor direct connected to two 500-KW., 1,200-volt generators, insulated to operate in series for 2,400 volts. The generators are compound wound, and have both commutating poles and compensating pole face windings. These fields are connected on the grounded side of the armature, and the main fields are separately excited from 125-volt exciters.

(To be continued.)



DUPLEX ELECTRIC TOWER CRANE.



SCOTCH ELECTRIC DERRICK CRANE.

ELECTRIC CRANES AT THE NEW COUNTY HALL BUILDINGS.

ELECTRICAL POWER APPLICATIONS IN THE CONSTRUCTION OF THE COUNTY HALL, WESTMINSTER.

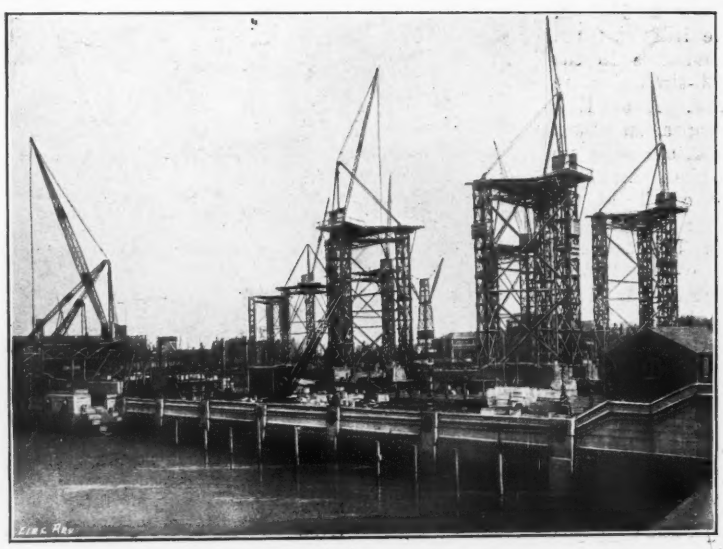
ELECTRIC current, as applied for power purposes, has had but little difficulty in showing its superiority over the old-fashioned steam plant in most industries. Undoubtedly, however, one of its most marked successes has been gained by its compactness, cleanliness and saving of expense for the use of the building and engineering contractor, where the former methods of using numerous isolated steam power plants entailed a prodigious amount of labour, fuel expense and general inefficiency.

By the courtesy of Messrs. Holland, Hannen & Cubitt, of Hyde Street, W.C., we have recently been able to inspect the construction works for the new County Hall at the southern end of Westminster Bridge, which they are carrying out as contractors for the future headquarters of the London County Council.

On these works, which cover a ground space of about 6½ acres, and have a river frontage of 750 ft., the most modern machinery and plant is being used, and some very interesting examples of electrical power application are to be seen.

The total number of motors at present installed amounts to 26, aggregating about 360 H.P., while additional plant now in course of erection will require a further supply of about 80 H.P.

For general lifting work at different points of the building, seven Scotch derrick electric cranes have been



GENERAL VIEW OF CRANE STRUCTURES AT THE COUNTY HALL SITE.

installed, while another of the same type is now in course of erection. These cranes, supplied by Messrs. Butter Bros., of Glasgow, have a lifting capacity of 5 tons at 78 ft. radius, and 2 tons at 60 ft. radius. They are of the single-motor type, equipped with a 20-H.P. motor, and having two lifting speeds of 60 and 80 ft. per minute. These cranes are raised on timber gantries 100 ft. above the ground level, each leg being ballasted with 20 tons of brickwork.

For handling the material brought by road, a large duplex electric tower crane has been installed on the portion of the works fronting the Belvedere Road. This crane, which was supplied by Messrs. Anderson & Co., is unique in its construction, being the only one of its kind at present in use, and was formerly used in the carrying out of the recent extension to the British Museum. It is of the travelling type, and runs on an 18-ft. track. Ascending to the operating platform, which is situated within the lattice girderwork tower at a level of 40 ft., we were able to obtain from the driver many interesting particulars of its construction and working. The total height of the tower is 100 ft. and it is equipped with two 45-ft. gibs, on opposite faces. Their slewing is effected by means of vertical shafts extending from the operating shed to a spur-and-pinion gear placed 35 ft. above the shed. The gibs have a maximum radius of 40 ft., and each can be slewed through an angle of 180°. The lifting capacity of each is 3 tons at 40 ft. radius, and 8 tons at 17 ft. radius. The motor equipment of the crane, which is by the Lancashire Dynamo Co., consists of one 22-H.P. motor for each gib, giving two lifting speeds of 20 and 60 ft. per min., and one 10-H.P. motor, situated at the base of the tower, for travelling. This is geared to the running wheels by double reduction worm gear. All the motors are of the series type.

Power is transmitted to the vertical slewing shafts from the lifting motors through a double friction clutch, and the gibbing is arranged so as to maintain the load at a constant level while varying the radius. The controllers of the shed motors are of the tramway pattern, and an Igranic worm-operated controller is provided for the travelling motor. The total weight of the crane, with 25 tons of ballast, is 75 tons. Its work consists of unloading the bricks, stonework and girders brought up by motor and horse lorries on the Belvedere Road, the bricks being taken up in skips of about three-quarters of a load at a time.

On the wharf a large 10-ton electric crane of the Scotch derrick type has been erected for dealing with the circular stone front on what is to be called the Members' Terrace, and this will unload the stone blocks from barges and place them direct in position. This crane is one of the largest of its type that has ever been made. The length of the jib is 137 ft., and the crane has a lifting capacity of 10 tons at a radius of 110 ft., and 4 tons at a radius of 125 ft.

In addition, two travelling wharf cranes are in the course of erection on the river front, for unloading other material from the barges, and depositing it on the site of the building. The length of the jibs of these cranes is 45 ft., and their lifting capacity is three tons at a radius of 40 ft.

An interesting example of labour saving by electrically-driven contractors' plant is provided by the concrete crushing and mixing machinery which has just been installed. This plant is situated on the river front of the works about 60 ft. from the wharf side. Either of the two wharf cranes mentioned will unload rubble and cement from barges on to a raised platform on which is placed the crushing plant consisting of a combined toggle-jointed jaw crusher and toothed crushing rolls in which the material is reduced to ¾-in. size. From here it descends through a rotary screen, to gauge skips on a lower platform, cement being passed down a separate shute to a suitable gauge also on this level. These gauges tip into a duplicate mixing plant placed in the sub-basement level of the building.

The crusher and screens are driven by countershafting from a 15-H.P. motor, while another motor of 15 H.P. is provided for the mixers. This entire unit is about to be duplicated by another of similar construction placed adjacent to it. The two will turn out about 200 cb. yd. of concrete per day under working conditions. Each unit will require only six men for its operation, showing a proportionate saving in working cost compared with the usual plant, which requires from 10 to 13 men, and produces only about 80 yd. per day. The concrete produced will be conveyed to any desired point of the works by a system of rails in the sub-basement on which it will be carried in skips of 20 cb. ft. capacity to any one of five electric hoists installed in the lift wells of the building. These hoists, each operated by a 10-H.P. motor, will have a useful lifting capacity of ¾ ton at 130 ft. per min.

A 10-H.P. electrically-driven mortar-mixing plant, provided with its material by the wharf cranes on the front of the building, will also be served by the skip railway.

For dealing with surface water collecting in the basement, two 20-H.P. electrically-driven centrifugal pumps are used and one of 5 H.P., while another of 5 H.P. is about to be installed.

Included among miscellaneous electrical tools for small operations are three grinding tables, each consisting of a 24-in. emery wheel running on a vertical shaft at 6,000 ft. per min. and driven by a 15-H.P. motor. These are used for shaping bricks and tiles for the formation of arches and other curves, and show a great superiority in finish to the older method of chiselling them by hand.

In the two carpenters' shops on the works, electrically-driven circulars saws are being used, one of 10 H.P. and two of 15 H.P.

The lighting of the works which is arranged for general rather than local illumination, is by 12 10-hour 9-ampere "Angold" flame arc lamps used four to the 230-volt circuit, and fixed at the height desired upon the various crane structures.

Electric power is obtained from the three-wire D.C. mains of the London Electric Supply Corporation, at 460 volts, through three separate services of armoured concentric cable, these being of ·8, ·5 and ·12 sq. in. area respectively. These service cables which, together with the distribution scheme, was carried out by Messrs. Donnison, Sillem & Co., Great Portland Street, terminate at distributing centres located at various points in the basement of the building, where they are split up into 75 and 50-ampere circuits, and led by concentric distributors to Siemens terminal boards, each circuit being separately metered. Ironclad fittings are used throughout, each power plant being efficiently earthed to separate earth plates, in conformity with the rules and regulations of the Board of Trade. The design of the various electric schemes has been in the charge of Mr. Ingram Pettit, consulting engineer, of Charing Cross Road.

The motors used throughout the works for the machinery and mixing plants were supplied by Messrs. Siemens.

We have to thank Mr. B. Tarring, works manager, for kindly taking such pains in verifying the accuracy of the above particulars; also his electrician, for spending a great amount of time in showing us around and explaining the various features of the plant.

Electrical Contracts in Turkey.—In the course of its annual report for 1913, the British Chamber of Commerce of Turkey and the Balkan States contains the following statement:—

"Electrical work of British Embassies and British Consulates without tender.—Your Council has been informed that certain electrical installation work had been given out to foreign firms without British firms having been invited to tender. Correspondence has ensued both with his Majesty's Embassy and with the Office of Works, with the result that the latter department has undertaken to invite tenders for all future work, and some five local firms representing British manufacturers have been put on the list."

In the issue of the *Journal* of the Chamber just received it is stated that "cases may be cited of British travellers in widely different articles accidentally taking in Constantinople on their way home from Egypt, and such purely accidental visits have been known to surpass all expectations. It should be remembered that it is the numerous small articles, from tooth-paste to office stationery, which can be developed. Turkey purchases nearly all her requirements abroad, and given a time of quiet, trade is bound to increase, as the imports have been cut down to the strictest necessary for a year or two past. The openings for the remunerative employment of capital in public works and enterprise are numerous. Railways and ports have to be constructed. Cities will be lit by electricity, and tractive power supplied. The mineral wealth of the country awaits capital and transport facilities for development. Local industries are almost nil, but with the prospective increase of the import duty from 11 to 15 per cent., and the exemptions from taxation and the facilities granted to industries, the time is at hand when new factories for every kind of manufactured articles, not requiring expert technical training, will spring up."

NOTES.

(*Continued from page* 536.)

Late Legal.—War Office Sue Electrical Engineers.—An action against Messrs. Kirkland & Capper, electrical engineers, of 17, Victoria Street, Westminster and Mr. John H. T. Woodd, an architect, of Broad Sanctuary Chambers, Tothill Street, Westminster, brought by the Secretary of State for War in connection with the defendants' supervision of certain electrical works erected by the War Office and entitled the new Medical Staff College and Laboratory at Millbank, came before Mr. Justice A. T. Lawrence, in the King's Bench Division on Wednesday. The Secretary of State for War claimed to recover damages against both the defendants in connection with their supervising direction of works. Both defendants denied being guilty of the negligence alleged against them.

For the War Office the Solicitor-General, Sir Stanley Buckmaster, K.C., M.P., Mr. Gordon Hewart, K.C., M.P., and Mr. Brandon appeared; for the defendant, Mr. Woodd, Mr. M. Shearman, K.C., and Mr. Eustace Hills (instructed by Dowson, Ainslie & Co.), and for the defendants Kirkland & Capper, Mr. J. A. Walter, K.C., and Mr. G. R. Blanco White (also instructed by Dowson, Ainslie & Co.).

The history of the case, said the Solicitor-General in opening, was quite simple, but something would depend upon the construction of the documents. In 1903 the War Office were engaged in constructing at Millbank this Medical College, a large and fine building, having residential quarters for the officers and a large laboratory. The defendant, Mr. Woodd, was engaged as architect on a commission of 5 per cent. on November 3rd, 1903, and it was his duty to superintend the whole of the works of the building, including the installation of electric lighting, but the contract expressly provided that the lighting work should be placed in the hands of experts. In February, 1904, the defendants, Messrs. Kirkland & Capper, were employed by the plaintiffs, through Mr. Woodd, to supervise the electrical lighting of the building. The acceptance was recommended to the War Office of two tenders submitted by Messrs. John Bolding & Sons for the installation, the amount being £838, in respect of the residential portion of the building, and £801 for the laboratories. These were accepted by the War Office early in 1906. Messrs. Bolding undertook to execute the work in accordance with the current Board of Trade regulations and the wiring rules of the Institution of Electrical Engineers.

In connection with the wiring of the building for electric light, it was stipulated that lead-covered wire should only be used in cases where the wires were passed through cornices, mouldings or walls, and the plaintiffs' complaint was that the defendants, Mr. Woodd and Messrs. Kirkland & Capper, had approved of the wiring of this place throughout with these lead-covered cables. A further ground of complaint was that the wires were hidden in plaster.

The defendants (it was alleged) took no steps to ascertain where the wires were laid that fed the lights, and the whole wiring work was extremely unsatisfactory, and it would be contended for the War Office that the certificate for payment for the work was negligently given. The system was found to be a failure, and then it was asserted that some of the circuits had gone wrong because attempts had been made to repair them by Royal Engineers, and this work had been clumsily and improperly done, but the plaintiffs' case was that this could not be possibly held to account for the utter failure which was found. The only remedy was to re-wire throughout, and this was done by Messrs. Foote & Milne in April, 1910. These were the facts of the dispute, and counsel would contend that there was a clear case of negligence against the defendants as supervisors.

At this stage Mr. Walter, K.C., remarked that he denied the negligence, and proposed to show that the trouble was caused by interference with the work after it was done.

Mr. Justice Lawrence said that, without expressing any opinion on the question of damages, it might appear when they got further that the matter would be so detailed that some expert or referee would have to investigate the items and calculate the possible damage.

The various documents and contracts were dealt with at great length by the Solicitor-General, who pointed out that the contract with Mr. Woodd provided that he should, as an architect, superintend the building, and have as remuneration a commission of 5 per cent. on the net cost of the building and works completed under his direction; and it threw on him the responsibility for the proper supervision of the execution of the work. Generally speaking, Mr. Woodd was to be responsible for the lighting, as also for the rest of the building under Clause 4.

The technicalities of electric wiring were explained in great detail by the Solicitor-General, and also the various acts which it was alleged were contrary to the contract, and to which the charge of negligence related.

Mr. Woodd, in his defence, totally denied negligence, and he referred to the fact that the contract provided for the electric lighting to be placed in the hands of experts, and that they were to be responsible to the War Office.

On behalf of Mr. Woodd, Mr. Shearman said he could state at once that his position was that he was architect for the building, and the engineers had to do with the electric lighting. Mr. Woodd would contend that he was not responsible for the electric lighting, except so far as seeing that the electric light works did not interfere with the proper building of the house. He was entitled to give instructions to the engineers in so far as it assured no interference with the building. The contract provided for the employment of electrical experts, and they were so employed, and Mr. Woodd's position, briefly put, was: "They are the engineers, I am the architect."

Sir Stanley Buckmaster said that what had caused this system to fail was the putting of lead-covered conductors into plaster without proper protection, and he could not see how any of the defendants could evade responsibility, as this was directly contrary to the terms of the contract.

[Our report will be continued next week.]

Colliery Explosions.—A new process for treating coal dust is being tried at Washington Colliery, County Durham, a liquid spray being used which does not evaporate.

Liverpool Electrical Trade Association. — It has been decided to form an association of the employers of electrical labour in Liverpool and district, to cover a 20-mile radius. Mr. Egerton G. Pulford is acting as secretary *pro tem.* An employer of labour stated that whereas over 80 per cent. of the men now belonged to a strong trade union the master electricians in the city were in no sense organised. Already within the last 12 months the rate of pay had been increased 1d. per hour, the standard rate now being 9½d. The employés were now asking for a further 2½d. per hour advance, and a reduction of working hours from 50 per week to 46½; night shift one hour less work or one hour at overtime rate; dinner hour not to be movable except at overtime rates; charge hands demanded 1d. extra instead of ½d., and under the heading of dirty work the men were asking for an extra 1s. per day each man. Starting time had usually been left to employers individually, but now it was proposed to have a fixed starting time of 8 o'clock. Increases were also asked in regard to overtime and Bank Holidays. What was most resented by many employers was the question of boundary, the E.T.U. now demanding that fares should be paid both ways to jobs, out in men's time, and back in employers' time. In the case of country jobs an increase of 1s. per day was asked for, all fares and travelling time to be paid. Most of the employers were determined to resist these proposals.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station Officials.—Having regard to the fact that its electrical engineer was one of the selected candidates for a similar position under the Salford Corporation, and that it is desirable in the interests both of the undertaking and the continuity of policy in connection with the position of the undertaking, to retain his services, the West Ham Corporation is being recommended to increase Mr. Beauchamp's salary to his present maximum of £700 per annum as from April 1st next, and to fix the future maximum at £900, to be reached by annual increments of £100, provided the Council may rely on retaining his services for a further period of two years at least.

Mr. W. Fennell, engineer and manager of the Wednesbury Corporation electrical station, has resigned, and the assistant manager, Mr. J. P. Smith, has been appointed to take charge.

The Fulham Borough Council, at its last meeting, increased the salary of the electrical engineer from £600 to £625. The approximate increase in salaries in the electricity department amounts to £160.

Mr. H. H. Jowers, of Stockport, has been appointed to the position of mains and permanent way superintendent in the Darlington Corporation electricity and light railways department.

The following advances in salaries have been made this week by the Manchester Corporation:—Mr. J. Wood, assistant tramways manager, £500 to £600, by four annual increments of £25 each; Mr. J. T. Oakes, tramways traffic superintendent, £475 to £500; Mr. J. A. Cookson, electric mains surveyor, £400 to £425; Mr. W. E. Foden, electricity department accountant, £425 to £450; Mr. F. E. Hughes, electricity department secretary, £475 to £500; Mr E. Bolton, electricity sub-station engineer, £375 to £400.

Mr. C. Handley, senior switchboard attendant at Birkenhead electricity works, has resigned his position in order to take up the duties of switchboard attendant and test room assistant at H.M. Dockyard, Devonport.

While feeling greatly flattered at the decision of the Salford Committee recommending that Mr. H. Richardson, Corporation electrical engineer, Dundee, be appointed to a similar post under the Salford Corporation at a commencing salary of £1,000 per annum, the Dundee Town Council does not like the prospect of losing the services of its electrical chief. Mr. Richardson, who is only 38 years of age, has been in Dundee since 1903, and his emoluments amount to £650. At a meeting of the Electricity Committee, Mr. Nairn, the Convener, said it would be a great loss to the department, indeed a calamity, if they lost such an able official, and if he was worth £1,000 to Salford he was surely worth the same to Dundee. The Convener submitted statistics to demonstrate the high efficiency to which Mr. Richardson had raised the department, and pointed out that the entire cost of the alterations of recent years, amounting fully to £26,000, was paid out of revenue. He moved that the engineer's salary be raised to £800, rising by annual increments of £50 to £1,000. In the discussion that followed, a member pointed out that from the business point

of view, no one would increase any manager's salary by 50 per cent. simply because he had got an offer from another firm which was doing twice the business and enjoying twice the profits. Bailie Macdonald said they should realise the value of a man and not wait until he got the offer of such a situation. While supporting an increase, Treasurer Soutar thought that if the Town Council in 1903 had the capacity to select a star like Mr. Richardson, they could do so again. The Convener's proposal was carried.

At a special meeting of the Dundee Corporation, on Monday, it was decided to raise the salary of MR. RICHARDSON, the electrical engineer, to £800, with increments of £50 a year until the maximum of £1,000 is reached, and a clause is added to the terms of service binding Mr. Richardson to remain at Dundee for five years. Mr. Richardson, it is understood, is prepared to accept the terms.

Tramway Officials.—The Southport Tramways Committee is to recommend the Council to increase the salary of MR. T. J. KENDREW, tramways manager, from £200 to £250 per annum.

MR. R. F. DIXON, who is leaving the Hull Corporation tramways to take up a position under the Southampton Corporation tramways, was the recipient on Wednesday last week, of a case of fish knives and forks, and a silver cigarette case, presented by the staff and employés. Mr. Elliott made the presentation on behalf of Mr. Wilkinson, who was unavoidably absent.

General.—On March 16th, MR. W. S. MURRAY was appointed by the New York, New Haven and Hartford Railroad Co. to be consulting engineer in general charge of all electrical engineering and construction, reporting to President Hustis, with offices at New Haven. Mr. Murray, following the substantial completion of the construction of the system for complete electrical operation west of New Haven, will enter into closer relations with the railroad company. His jurisdiction will hereafter be extended to also include the electrical features of operation in addition to electrical construction. He will continue with the firm of McHenry & Murray in general consulting practice as before.

MR. P. J. WHITE, general manager of the London Electric Warehouse Co., was married, on the 5th inst., at St. Mary Abbot's, Kensington, to Miss Pauline Scott.

SIR FRANCIS HOPWOOD, G.C.M.G., K.C.B., has been appointed to a seat on the general board and Executive Committee of the National Physical Laboratory, in the place of Sir Arthur Rücker, F.R.S., resigned.

SIR HENRY BABINGTON SMITH has been appointed as a member and chairman of the Pacific Cable Board, in succession to Sir Henry Primrose, resigned.

MR. E. G. THOMAS, charge engineer at the Burslem electricity works, who is taking up a similar position at Sheffield with Messrs. John Brown & Son, has been presented by his colleagues with a set of silver-mounted military brushes.

The electrical staff of the Great Western Railway at Swindon have presented a barometer to MR. H. G. SUTCLIFFE on his marriage.

Obituary.—MR. WILLIAM HOLT, formerly in charge of the electricity plant at the Blackburn Technical School, died at Alberni, British Columbia, last week, at the age of 68 years.

The death is reported of MR. FREDERICK EVAN EVANS at the age of 80 years. The deceased gentleman, who passed away at Hastings on 20th inst., was superintending engineer in the Postal Telegraph Department at Birmingham. He, of course, retired from the service many years ago.

NEW COMPANIES REGISTERED.

Adaptable Code Condensers, Ltd. (134,711).—This company was registered on March 20th, with a capital of £1,000 in 850 5 per cent. cumulative preference shares of £1 each and 3,000 ordinary shares of 1s. each, to carry on business as experts in, advisers upon and teachers of the art of condensing matter intended for transmission by cable or by telegraphy or any description, whether by wire or wireless, proprietors, inventors, compilers, adaptors of or advisers upon telegraphic codes, &c., and to adopt an agreement with H. G. Telling. The subscribers (with one preference share each) are:—H. G. Telling, 7, Pearfield Road, Forest Hill, S.E., gentleman; W. T. Duke, The Chestnuts, Cranleigh, Surrey, gentleman. Private company. The number of directors is not to be less than two or more than seven; the first are H. G. Telling and W. T. Duke; qualification of H. G. Telling, 2,000 ordinary shares; of W. T. Duke, 300 preference shares; of other directors 100 ordinary shares; remuneration (except managing director) £20 per annum, divisible. Registered by Freeman & Son, 30a, George Street, Hanover Square, W.

Vincent Pump and Transmitter Co., Ltd. (134,675).—This company was registered on March 18th, with a capital of £15,000 in 5s. shares, to carry on the business of mechanical, electrical and general engineers and contractors, manufacturers of pumps, hydraulic apparatus and machinery, tool and boiler makers, &c., and to adopt an agreement with the Rotoplunge Pump Co., Ltd. The subscribers (with one share each) are:—H. T. Box, Preswylfa, Cardiff, solicitor; L. Morgan, Duffryn, Llandaff, solicitor; E. Neal, Beaumont, Whitchurch, Glamorgan, tea and coffee merchant; W. H. Taylor, Bradstow, Cefn Coed Road, Cardiff, merchant; J. H. Morgan, 26, High Street, Cardiff, solicitor; D. E. S. Browne, 23, Parade, Barry, solicitor, F. H. Gentle, 66, Llanfair Road, Cardiff, clerk. Minimum cash subscripton 25 per cent. of the shares offered to the public; the number of directors is not to be less than three or more than seven; the first are J. Hibbert, H. T. Box, L. Morgan, W. H. Taylor, H. A. Moore and J. Browne-Martin; qualification, 20 shares; remuneration (except managing director), £50 each per annum (chairman, £65); solicitor, J. H. Morgan, 26, High Street, Cardiff.

Electrolysers, Ltd. (134,651).—This company was registered on March 18th, with a capital of £2,200 in 2,000 pref. shares of £1, and 4,000 ordinary shares of 1s. each, to acquire from J. T. Niblett certain inventions for improvements in electrolytic apparatus, a method of and means for producing a bleaching, disinfecting, deodorising and preserving agent, and in apparatus for bleaching fabrics, together with the patents to be granted in respect thereof, to carry on the business of electricians, electrical engineers, bleachers, dyers, &c. The subscribers (with one pref. share each) are:—A. Moy, 19, Old Broad Street, E.C., financial agent; J. G. Watson, 88, Bishopsgate, E.C., financial agent. Private company. The number of directors is not to be less than two or more than five; the first are J. T. Niblett and J. G. Watson; remuneration, £25 each per annum, and a percentage of the profits.

General Acoustic and Dictograph Co., Ltd. (134,688).—This company was registered on March 19th, with a capital of £6,000 in £1 shares, to take over from the General Acoustic Co., of New York, the benefit of certain acoustic and telephonic inventions, to carry on the business of makers of instruments for the deaf, manufacturers of and dealers in anatomical, orthopædic and surgical appliances, chemists, druggists, providers of requisites for hospitals, patients and invalids, telephone instrument makers, &c. The subscribers (with one share each) are:—J. McL. Whitfield, Beechfield House, Birkby, Huddersfield, pianoforte dealer; W. A. Butler, Clarence Villa, Clarence Road, Wimbledon, S.W., gentleman. Private company. The number of directors is not to be less than two or more than five; the subscribers are to appoint the first. Registered by Walter Martin & Co., 32, Queen Victoria Street, E.C.

E.M.F. (1914), Ltd. (134,649).—This company was registered on March 18th, with a capital of £3,000 in £1 shares, to take over the business of electricians, electrical engineers and fittings makers carried on by E.M.F., Ltd., at London and Walsall, and to adopt an agreement with G. Little (liquidator of E.M.F., Ltd.), and W. H. Rowe. The subscribers (with one share each) are:—W. H. Rowe, "Beverley," Stoneleigh Drive, Worcester Park, Surrey, electrical engineer; J. M. Bein, 91, Belvedere Road, Walsall, Staffs, electrical engineer. Private company. The number of directors is not to be less than two or more than three; the first are not named. Solicitor, F. Cooper, Walsall.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Tramways Light and Power Co., Ltd.—Trust deed dated February 26th, 1914, to secure £200,000 debenture stock redeemable at a premium of 5 per cent., with power to create and issue further stock, ranking *pari passu* with above, but so that the total amount shall not at any time exceed 75 per cent. of the aggregate amount for the time being issued of the preferred and ordinary share capital, charged on 136,468 shares of £1 each, and £36,785 5 per cent. debenture stock of the Derbyshire and Nottingham Electric Power Co., 20,500 shares of £10 each of the Nottingham and Derbyshire Tramways Co., 7,510 shares of £10 each in the Leicestershire and Warwickshire Electric Power Co., 194 preferred and 6,528 ordinary shares of £10 each, and 32,950 debenture stock of the Leamington and Warwick Electrical Co., 3,139 shares of £10 each in the Midland Electric Light and Power Co., Ltd., present and future, rights and interests of the company, in or to such shares, debenture stock and debenture scrip and the company's undertaking and other property, present and future, including uncalled capital. Trustees: Trustees, Executors and Securities Insurance Corporation, Ltd., Winchester House, Old Broad Street, E.C.

Burnham and District Electric Supply Co., Ltd.—Debenture, dated March 12th, 1914, to secure £3,000, charged on the company's undertaking and property, present and future, including uncalled capital. Holders: Wilts. and Dorset Banking Co., Ltd., Salisbury.

Broom & Wade, Ltd.—Debenture, dated March 4th, 1914, to secure not more than £4,000, charged on the company's undertaking, real and personal estate, property, patents, and issued or uncalled capital. Holders: Barclay & Co., Ltd., 54, Lombard Street, E.C.

Yorkshire (West Riding) Electric Tramways Co., Ltd. (94,167).—Capital, £600,000, in £5 shares (70,000 pref. and 50,000 ord.). Return dated February 6th, 1914. 46,261 pref. and 40,977 ord. shares taken up, £436,190 paid. Mortgages and charges: £275,000.

Central Electric Supply Co., Ltd. (53,080).—Capital, £100,000, in £5 shares. Return dated February 17th, 1914. All shares taken up, £100,000 paid. Mortgages and charges: £458,600.

Nottinghamshire and Derbyshire Tramways Development Co., Ltd.—A memorandum of satisfaction in full on March 13th, 1913, of debentures, dated June 22nd, 1910, and October 2nd, 1911, securing £1,875, has been filed. (Notified March 19th, 1914.)

Madras Electric Supply Corporation, Ltd.—Issue on March 12th, 1914, of £4,000 debentures, part of a series of which particulars have already been filed.

City of Oxford Electric Tramways, Ltd.—A memorandum of satisfaction in full on February 24th, 1914, of debentures, dated December 14th, 1908, securing £15,000, has been filed.

Cecil Hodges & Co., Ltd.—Capital, £1,000 in £1 shares. Return dated November 4th, 1913 (filed February 11th, 1914). All shares taken up. £1 per share called up on two. £2 remains in arrears. £998 considered as paid on 998 shares. Mortgages and charges: £500.

Electric Train Lighting Syndicate, Ltd. (112,932).—Capital, £5,200 in £1 shares. Return dated March 2nd, 1914. All shares taken up. 5s. per share called up on 900. £225 paid. £1 per share considered as paid on 4,300. Mortgages and charges: Nil.

CITY NOTES.

British Insulated and Helsby Cables, Ltd.

DR. E. K. MUSPRATT presided over the annual meeting held in Liverpool on Monday, and in moving the adoption of the report (see ELECTRICAL REVIEW, page 501), he stated that the profit for the year amounted to £247,351, as compared with £218,395 for the previous year, an increase of £28,956, results which he was sure would be regarded as satisfactory. He was pleased to be able to say that the good results had been obtained not through extraordinary profits or volume of business, but by a general increase of business in the various departments. It was only fair to state, however, that competition in their line of business was somewhat on the increase, but they felt confident that the company would be

fully able to deal with this. While prospects of trade generally throughout the country were not so good as they were, their works still continued to be fully employed, and some contracts of exceptional magnitude were at present on hand, notably the making and laying complete of large quantities of telephone cable for the General Post Office. With regard to the profit and loss account, the chairman said that adding the balance brought forward from 1912, there was an available sum of £321,581. Out of this the directors' and trustees' fees had been paid, with interest on debenture stock, a preference dividend, and interim dividend on ordinary shares. Sums had also been written off to depreciation, and £35,000 had been written off patents and goodwill, reducing the last item to nil. The item had originally stood at £251,672, and its annihilation should very materially strengthen the financial position of the company. The directors were following the policy of judiciously extending the company's manufacturing plant to meet the demand in the departments returning the best profits. Their interests in subsidiary companies were improving, and it might be anticipated that they would year by year form an increasing source of strength. Owing to the insufficient supply of workmen's dwellings at Prescot, and the long distance the men had consequently to travel daily, the directors were contemplating the development of a site near the works on town-planning lines. In conclusion, the chairman paid a tribute to the hard and intelligent work of Mr. Sinclair, the general manager, and other principal officials of the company.

Mr. James Taylor seconded the motion, which was carried unanimously.

A dividend of 9s. per share on the ordinary shares, making with the interim dividend previously paid a return of 13 per cent. for the year, was approved of. Messrs. James Taylor and G. Crosland Taylor, the retiring directors, were reappointed.

Guildford Electricity Supply Co., Ltd.

The directors' report for December, 1913, shows that the company has again made very satisfactory progress, the gross receipts being £11,786, as compared with £10,069, an increased revenue of £1,717. The accounts show a balance on the revenue account of £4,044 (after crediting depreciation fund account with £1,250) as compared with a balance of £3,705 (after crediting depreciation fund account with a like amount), on the revenue account for 1912. After making due provision for debenture interest, dividend on preference shares, &c., and the placing of £500 to the credit of reserve fund account, the net revenue account shows a balance of £1,166 for distribution. Out of this sum the directors recommend the payment of a dividend at the rate of 5 per cent., less tax, for the past year on the ordinary share capital, which will absorb £758, thereby leaving £408 to be carried forward to the credit of the net revenue account for the present year. The following table shows the progress of the business :—

Year.	Number of connections.	Total revenue.	Total costs.	Gross profit.
1911	874	£8,679	£4,376	£4,303
1912	969	£10,069	£5,114	£4,955
1913	1,090	£11,786	£6,492	£5,294

This undertaking, in common with other undertakings of a like nature throughout the country, has suffered in consequence of the heavy rise in the cost of fuel during the past year.

Units sold, lighting, 370,125, as compared with 331,930 for 1912; power and heating, 672,475, as compared with 437,896; total, 1,042 600, as compared with 769,8 '6; H P. motors connected, 810, as compared with 753; total number of connections, 1,090, as compared with 969.

Newmarket Electric Light Co., Ltd.—The directors' report for 1913 shows that the equivalent of 1,918 33-watt lamps have been connected to the mains, making the total connected 29,729 lamps. Applications for a further 300 lamps have been received this year. The profit on working, added to £61 brought forward, amounts to £2,692, which, after providing for debenture and other interest, £733, leaves a balance of £1,958. A dividend of £4 per cent. is recommended, that £750 be carried to reserve for renewal of plant, and that £146 be carried forward. Mr. Albert Lane has been elected a director in place of Mr. F. W. Cobb, who retired on account of ill-health.

Folkestone Electric Supply Co., Ltd.—At the annual meeting the chairman (Alderman Spurgen) congratulated shareholders on the extremely satisfactory increase in the business during the past year. There was now, he said, being supplied the equivalent of 7,847 8-C P. more lamps. He summarised the results stated in the report (see Electrical Review, page 500). The subsidiary branch at Sandgate had purchased current to the amount of £817, which was sold at 6d. per unit, and realised £1,283; and Hythe had taken current of the value of £2,354, and sold it at £3,806. The report was adopted.

O. C. Hawkes, Ltd.—After paying 5 per cent. on the preference shares, £3,006 is to be carried forward. An 11 weeks' strike disturbed the business and, ending in a considerable advance in wages, affected the profits, but good relations now exist.

Globe Telegraph and Trust Co., Ltd.—An interim dividend at the rate of 2s. per share on the ordinary shares is payable on 31st inst.

Robey & Co., Ltd.—The profits for 1913 were £25,412. A dividend of 5s. per share is to be paid, carrying forward £5,630.

Continental Electrical Companies.

The report for 1913 of the *Swiss Electrical Industry Co.* (*Schweiz-Gesellschaft fur Elektrische Industrie*) of Basle, which is closely associated with the group of the Siemens & Halske Co., states that the company took over portions of new issues in the Societa Elettrica Riviera di Ponente and the Siemens Elektrische Betriebe, and the underwriting business also experienced changes. The gross profits amounted to £180,000, as compared with £136,000 in 1912, and the net profits were £69,200, as against £69,300; the dividend proposed is at the rate of 7 per cent. on ordinary share capital of £800,000, being the same as in 1912. During the year the company made a fresh issue of £600,000 in bonds, thus increasing the loan capital to £2,400,000.

The report of *Felten & Guilleaume, A.G., of Vienna*, states that the stock of orders brought over from 1912 afforded adequate work and equivalent profits in the first half of 1913, but business became slacker with every succeeding month, and restrictions in working had to be made. After placing £16,900 to the depreciation account, as compared with £18,300 in 1912, the accounts show net profits and balance forward amounting to £92,100, as against £117,160 in the previous year. It is proposed to pay a dividend of 15 per cent., as contrasted with 17½ per cent. in 1912. The report remarks that no improvement in activity has taken place in the new (the current) financial year, and it is not expected that a decided change in the situation will occur in the near future. If, however, the monetary requirements of the Government are met, the company estimates that large orders will be received from the State. It is added that the stock of orders standing over from 1913 is considerably less than a year ago.

The balance-sheet of the *Société Suisse pour l'Industrie Electrique*, of Basle, Switzerland, for the last financial year, shows a net profit of £69,655, as compared with £69,350 in 1912. A dividend of 7 per cent. is again being declared.

The *Société Industrielle des Telephones*, of Paris, reports a net profit of £68,370 for the last financial year. It has been decided to apply a sum of £25,200 to depreciation, £2,045 to legal reserve, £430 to bonuses, while the shareholders are to receive £38,400 in dividends, leaving £2,295 to be carried forward.

The report of the *Kabelfabrik und Drahtindustrie Gesellschaft*, of Prague, for the last financial year shows a net profit of £50,723, as compared with £41,850 in the preceding year. The net profit in the case of the Kabelfabrik Gesellschaft, of Pressburg, amounts to £27,242, as against £27,303 in 1912. In both cases a dividend of 12 per cent. is being repeated.

The report for last year of a number of electrical undertakings in Italy have lately made their appearance. *La Societa Electricita Alta Italia* made a net profit of £61,969, as compared with £62,088 in 1912. A dividend of 5½ per cent. is again being declared on a capital of £1,000,000. The net profit reported by the *Union Italiana dei Tramvie Electricchi*, of Genoa, amounts to £78,448, as contrasted with £78.214. The same dividend as in 1912, 9½ per cent., is being paid. The balance-sheet of the *Societa Siciliana d'Entreprises Electricas*, of Milan, shows a profit sufficient to pay a dividend of 8 per cent., and to apply a sum of £16,000 to reserve and depreciation. The net profit of the *Societa Officine Electrica*, of Genoa, has advanced from £69,539 to £89,268. The shareholders are receiving a dividend of 10 per cent. The *Societa Adriatica d'Electricita*, of Venice, reports a net profit of £46,640, as against only £32,112 in 1912. The dividend is being increased from 6 to 7 per cent. The report of *Societa Idro-Electrica Ligure*, of Milan, shows that the net profit increased from £20,492 to £28,375. The shareholders are receiving an 8 per cent. dividend, as compared with only 7⅛ per cent. in 1912. The *Societa Ligure-Toscana d'Electricita*, of Leghorn, is increasing its dividend from 6½ to 7 per cent.

London United Tramways, Ltd.

The directors' report for 1913 shows gross receipts amounting to £337,194. Including the balance brought forward, and deducting all expenses chargeable to revenue, including an appropriation of £20,000 to the reserve for reconstruction and renewals, there remains a balance of £14,601. It is proposed to pay a dividend on the preference shares at the rate of 1 per cent. per annum, £12,500, carrying forward £2,101. Expenditure during the year to the amount of £12,825 has been charged to the reserve for reconstruction and renewals, and £2,637 to general reserve. The gross traffic receipts, in spite of a smaller car mileage, show the satisfactory increase of £5,662 over those of 1912. Owing, however, to the increased cost of coal and material, and to special expenditure on permanent way and overhaul of rolling stock, the net profits show a decrease of £5,635. The work of welding the joints on the older lines has been completed. Pending a final settlement in the matter of the purchase of the company's tramways in Hammersmith the L.C.C. has agreed to make further advances to the company for the reconstruction of the remainder of the older lines within the Borough, and the work is almost completed. The directors have given their careful consideration during the year to the rates of pay and conditions of labour in various grades. As a result, amongst other concessions to employees, the directors have made a substantial increase in the rate of pay of conductors. A Bill is being promoted by the company in the present Session of Parliament to empower them to enter

into working agreements with the owners of tramways and railways and for various other purposes.

TRAFFIC SUMMARY.

	1912.	1913.
Mileage open at 31st December ...	53.5	53.5
Passengers carried	61,139,285	62,645,125
Car miles run	9,474,504	9,407,226
Average receipts per car mile	8.36d.	8.55d.
Average receipts per passenger ...	1.30d.	1.26d.
Cars in stock at 31st December ...	338	338

The meeting was held on Wednesday.

British Aluminium Co., Ltd.

The directors' report for the year to 31st December, 1913, states that the trading profit for the year, together with interest and dividend on investments and deposits, and the revenue derived from Kinlochleven and Foyers Estates, and transfer fees, was £268,720, plus £10,207 brought forward.

This has been dealt with as follows:—Provision for income tax, legal expenses, bad and doubtful debts, depreciation of investments and furniture and proportion of profits payable to directors, £23,007; prior lien debenture service fund, £48,000; debenture stock service fund, £43,224; reserve for depreciation, £50,000; carried to reserve account, £50,000; leaving £64,696. The directors recommend the dividends of 6 per cent. per annum on the preference share capital, requiring £17,974, and of 5 per cent. per annum on the ordinary share capital, requiring £30,031, leaving to be carried forward, £16,690. The dividends will be paid on 1st April. It is now proposed that the dividend on the preference shares be paid half-yearly on 1st April and 1st October in each year. The interim dividend in respect of the current year will be paid on 1st October, 1914. The reserve account, including £50,000 added out of the profits of the year, amounts to £130,000. The depreciation reserve account, including £50,000 set aside out of the year's profits, now stands at £150,000. The various works of the company have been operated satisfactorily during the year. Additional plant has been installed at the aluminium works at Vigelands, Norway, thereby increasing the productive capacity of these works. The new rolling mills at Warrington, Lancashire, are now in operation, and the power plant for these works is in course of erection. Arrangements have been made for a temporary supply of power meantime. Land has been acquired at Burntisland, Scotland, and arrangements are in course of preparation for the erection of a works for the manufacture of alumina for supply to the company's factories in Norway and elsewhere. Further extension is also required to the works at Kinlochleven for the manufacture of carbon electrodes, and arrangements are in progress in this connection. The company has purchased from its subsidiary company a large tonnage of good quality bauxite, in order to secure a reserve of raw material. This will only be used if and when required to supplement the supply under existing contracts. The output and sales for the year have been satisfactory. The prices obtained show a considerable improvement over the previous year. The demand for the metal continues to increase, although at the present time there is a temporary slackness, due to the general falling off in trade in the chief markets at home and abroad. There is no change to report with regard to the Orsières power and railway schemes. The company's rights and interests are properly safeguarded.

The meeting is to be held to-day.

Metropolitan Electric Tramways, Ltd.

The directors' report for 1913, shows that the revenue was £539,246. Including the amount brought forward and deducting all expenses chargeable to revenue, there remains an available balance of £52,282, out of which £12,000 is to be placed to reserve account; £25,000 is required for dividend on the preference shares; dividend on the ordinary shares at the rate of 3 per cent. absorbing £14,230; £1,052 being carried forward. In March last the directors issued £50,000 5 per cent. debenture stock, the balance of the total amount authorised. £4,740 4½ per cent. debenture stock and £2,500 5 per cent. debenture stock was bought and cancelled during the year under the provisions of the trust deeds. The Metropolitan Electric Tramways (Railless Traction) Act, 1913, received the Royal assent in August. Negotiations are proceeding for the transfer to the Middlesex County Council of the powers conferred upon the company by the Act. The through running arrangements with the L.C.C. referred to in the two preceding reports have been extended to other service routes converging at Finsbury Park, and the company's cars now run to the Euston, Holborn and Smithfield termini of the County Council's system. The facilities thereby given of travelling between the centre of London and the various northern suburbs without the necessity of changing cars are greatly appreciated by the travelling public. The agreement with the L.C.C., under the terms of which the company had for five years the exclusive user of the short length of tramway in the Archway Road, Highgate, expired in December last, and has been temporarily renewed pending the completion of negotiations for the institution of a through service between Barnet and London *via* that tramway. An agreement has been entered into with the Hertfordshire County Council for the abandonment of the authorised light railways in Watford and Bushey, the directors being of opinion that the revenue obtainable from those districts would not yield a sufficient return upon the capital expenditure which the construction of the railways would involve.

TRAFFIC SUMMARY.

	1912.	1913.
Mileage open	56.250	56.250
Passengers carried	91,508,693	94,426,011
Car miles run	11,482,870	12,225,429
Average receipts per car mile	9.63d.	9.31d.
Average receipts per passenger	1.211d.	1.209d.
Cars in stock	312	312

The meeting was held on Wednesday.

North Metropolitan Electric Power Supply Co., Ltd.

The directors' report for 1913 states that the revenue was £164,407, an increase of £21,445 over 1912, and the expenditure £85,773, an increase of £14,145. The balance of £78,634 at the credit of the account compares with £71,334 in 1912. Adding interest and dividends receivable and the amount brought forward from last account, there is a total of £89,083. After providing for mortgage, loan and debenture interest, transferring £2,000 to reserve to secure the debentures, and placing £21,150 to the credit of the depreciation account (increasing it to £100,000), the dividend on the 6 per cent. cumulative preference stock and the payment of a dividend at the rate of 6 per cent. per annum, together with a bonus at the rate of 12s. per fully-paid share on ordinary shares, there is £1,054 to be carried forward. The capital expenditure during the year amounted to £66,484, making the total £732,252. A further issue of £40,000 5 per cent. mortgage debentures, to which reference was made in the last report, was sold in April, 1913. During the year the third and the final instalments, amounting to £50,000, on the £100,000 6 per cent cumulative preference stock issued in 1912, were paid up. The directors have accepted an offer for the purchase, at a premium, of a further issue of £100,000 6 per cent. cumulative preference stock. The total number of units sold was 34,430,384, which, compared with the previous year's figure of 29,231,099, is an increase of 5,199,285 units, or approximately 18 per cent. The building and plant extensions in connection with the Brimsdown and Hertford power stations referred to in the last report are now completed. The extensions of the Willesden and St. Albans power stations are still in progress. The shareholders have approved a Bill which has been deposited in the 1914 Session of Parliament to increase the authorised capital of the company to £1,000,000, and to confer further powers on the company and the North Metropolitan Electrical Power Distribution Co., Ltd. The business of the North Metropolitan Electrical Power Distribution Co., Ltd., continues to develop satisfactorily, and a dividend at the rate of 6 per cent. has been paid by that company in respect of the past year.

The annal meeting was held at the Electrical Federation Offices, W.C., on March 20th, Mr. E. Garcke presiding.

The Chairman, in moving the adoption of the above report, said that as the whole of the ordinary shares were held by the Metropolitan Electric Tramways Co., any remarks he made were addressed to the preference stockholders. The position of the company, both from the point of view of the ordinary shareholders and of the preference stockholders was a very satisfactory one. The ordinary shareholders were receiving a larger dividend, while the preference shareholders were receiving 6 per cent. per annum through good and bad times, which could not be described as a small return seeing that they had priority both as to dividends and capital, and that the profits of the company were sufficient to cover the preference dividend nearly five times. The growth of the company's business continued satisfactory. The units sold last year amounted to 34½ millions, or an increase of 18 per cent. over the preceding year. The revenue for the past year amounted to £164,400, which was an increase of £21,000, equal to about 15 per cent., over the revenue of the preceding year. One, perhaps, unsatisfactory feature was the fact that the expenses of generation did not go down in the same ratio as the volume of business increased. There had been no actual increase of the generating expenses so far as the administrative expenses were concerned, and, indeed, they were rather less, but they had had to pay something like £3,500 more for rates and taxes, which represented about one per cent. on the ordinary capital. The reason the generating expenses did not go down relative to the increased output as might be expected was that they had had to pay more for coal and other items necessary for production. However, there was in the opinion of the directors every reason to be hopeful for the future. They expected a still further extension of business and they hoped to be able to secure a reduction of costs if that were possible. The load upon their stations having increased very considerably, they had had to enlarge the plant at all their power houses, and the extension of the main to which they made reference in the last report was now, of course, being carried out. It would involve a somewhat large expenditure of capital, but they were satisfied that it would fructify and fully justify itself in the course of a few years. This extension necessitated an increase of capital. They issued some more preference stock last year, and

also a small amount of debenture stock. They proposed to issue a further £100,000 of preference stock in the course of this year. They obtained a very satisfactory price for the stock they issued last year, and they had been able to place the £100,000 preference stock which they proposed to issue this year at practically the same figure, which he thought spoke very well for the credit of the company. They had received a 6 per cent. dividend from the North Metropolitan Electrical Power Distribution Co., of which they held the whole of the shares. That company was progressing very nicely and the business was developing satisfactorily. Their contribution to the depreciation fund had now raised that fund to £100,000, which, they would agree, was a very substantial sum in relation to the paid-up capital. Shareholders might have expected him to say something with regard to the scheme for dealing with the London electric supply situation, but fortunately they were outside that controversy and he need make no reference to it. They had a Bill in Parliament in which they sought power to increase their capital and to make various modifications in the existing acts which experience had shown to be desirable. In conclusion, the Chairman congratulated the shareholders on the efficient management of the company under Mr. Devonshire and his very able staff.

Sir Ernest Spencer seconded the motion and it was agreed to.

British L. M. Ericsson Manufacturing Co., Ltd.

The ordinary general meeting was held on March 18th at the Memorial Hall, Farringdon Street, E.C., under the chairmanship of Mr. W. M. Crowe.

In proposing the adoption of the report (see Elec. Rev., page 415), the Chairman said that the company continued to make good progress; and that the prospects for the current year were exceedingly good. The net profit for the past year had amounted to £23,809 and that was after writing off £10,503 for depreciation and paying debenture interest of £2,500. That result might be considered as a very fine one in view of the fact that wages had gone up considerably during the year and other expenses had increased. The net profit for the previous year was £18,563, so that last year there was a net increase of £5,219. The depreciation might be considered a generous allowance, and he would like to point out that the company had been very particular in writing down its capital assets each year from the commencement. He noticed that some newspapers stated that although they deducted £10,500 for depreciation in 1913 nothing was debited in 1912. As a matter of fact they put £10,000 aside that year and during the past six years they had written off no less than £69,000 for depreciation. That, he thought, proved that they had been very liberal in their writings off. In addition they had always kept up the standard efficiency of the plant, buildings, and machinery at their factory at Beeston, and each year they had written off liberally any doubtful stocks. Those facts, and the fact that no amount stood in the books for goodwill, patents, or any such thing, proved that the company was in a sound and healthy condition. The directors recommended that the balance of the preliminary expenses, which in the ordinary way would have been spread over four years, be entirely written off, which left the company absolutely without a single doubtful asset of any kind. The past year was fairly satisfactory as far as orders were concerned, but he regretted to say it was necessary to cut prices often to a very fine point so as to secure orders from the Post Office. Had it not been that they had had a large amount of work other than telephone work the result would not have been as good as it was. That outside work was becoming an important factor in the company's business and the directors were doing all in their power to encourage and extend it. It seemed that the telephone had not made such progress in this country as it was expected it would when the Post Office took over the business of the National Telephone Co., and the consequence was there was not sufficient work in the country for all the telephone manufacturers. Therefore they had to look elsewhere in order to keep their factory going. They had a scheme in hand at the present time by which they hoped to tap a source of telephone work that was new to them as a company. In the past they had confined themselves to making and supplying only high-class telephone material such as was required by the Post Office and other Government offices and the Colonies, and they had left the making of the cheaper class material to other manufacturers. They intended now to go into that business and to appeal to the contractor whose business it was to supply telephones to private houses, factories, hotels, &c., and they hoped to secure a part of that business. It was a growing business and would increase as the telephone became more indispensable. Their policy had always been to keep up the standard of workmanship and finish for which their Beeston factory had been noted, and they intended to keep up that standard for all Government work and for such work as they put into the switchboard which they supplied last month to Windsor Castle; but they must produce the cheaper class instrument in order to meet the demand he had referred to. At their factory they had machinery of the very latest type; they had an enormous capacity for turning out work cheaply.

Mr. Harold Sands seconded the resolution and the report was adopted without discussion.

London and Suburban Traction Co., Ltd.

The directors, in their report for the period ended 31st December, 1913, state that the company was incorporated in November, 1912, for the purpose of consolidating the interests of the shareholders in the Metropolitan Electric Tramways, Ltd., the London United Tramways, Ltd., and the Tramways (M.E.T.) Omnibus Co., Ltd., and for acquiring interests in other similar concerns. The following is a list of the shares acquired:—

	Total Number of Shares issued.	Shares Acquired at 31st Dec., 1913.
Metropolitan Electric Tramways, Ltd.—		
£1 Preference (fully paid)	500,000	448,463
£1 Ordinary (fully paid)	474,336	461,915
London United Tramways, Ltd.—		
£10 Preference (fully paid)	125,000	121,069
£10 Ordinary (fully paid)	100,000	97,935
Tramways (M.E.T.) Omnibus Co., Ltd.—		
£1 Ordinary (1/- paid)	200,000	200,000
South Met. Elec. Tramys. & Ltg. Co., Ltd.—		
£1 Preference (fully paid)	169,569	168,246
£1 Ordinary (fully paid)	181,190	181,190
Gearless Motor Omnibus Co., Ltd.—		
£1 Ordinary (fully paid)	28,040	2,490
Do. do. (16/- paid)	10,000	10,000
1/- Deferred (fully paid)	100,000	Nil.

By means of these investments the company has secured important interests in tramway, omnibus and electric supply undertakings operating within Greater London, and these are detailed in the report.

The undertakings and operations of the North Metropolitan Electric Power Supply Co. (the only shares of which are held by the M.E.T., Ltd.), and the N.M.E.P.D. Co. (the whole of whose capital is held by the N.M.E.P.S. Co.), and the South Metropolitan Electric Tramways and Lighting Co., Ltd., are also summarised in the report.

The capital of the company at 31st December, 1913, was as follows:—

	Authorised.	Issued & fully paid.
4½ per cent. First Mort. Deb. Stock	£550,000	£179,385
5 per cent. Cum. Pref. Shares of £1 each	£1,700,000	£1,591,999
Ordinary Shares of £1 each	£1,900,000	£1,840,270

With the exception of the 507 preference shares taken up by the signatories to the memorandum and articles of association, which were paid for in cash, the whole of the above debenture and share capital was issued as fully paid in connection with the acquisition of shares in other companies. For the purpose mainly of providing the funds required for the completion of the purchase of the omnibuses of the Tramways (M.E.T.) Omnibus Co., Ltd., the company has obtained advances from its bankers amounting at 31st December last to £160,000. The directors have made arrangements for an issue of capital for the purpose of repaying these advances and providing additional working capital for the subsidiary undertakings. The company's revenue for the period under review, consisting almost entirely of the dividends and interest receivable upon its investments in and loans to the subsidiary companies, amounted to £105,371. After deducting all expenses chargeable to revenue, including debenture and loan interest, there remains a balance of £88,252. Out of this the 5 per cent. dividend on the preference shares has been paid, leaving a balance of £8,597, which the directors propose to carry forward. The directors anticipate that the income of the company from investments will be considerably larger in future years, especially as the omnibus fleet was not in full service until August last.

Direct Spanish Telegraph Co., Ltd.

The 62nd ordinary general meeting was held on March 18th at Electra House, E.C., Sir J. Denison Pender, K.C.M.G., presiding.

The Chairman, in moving the adoption of the report (see Elec. Rev., page 448), said the traffic receipts showed an increase of £65. That was hardly worth mentioning by itself, but when it was taken in connection with the increase in 1912, which amounted to over £3,000, he thought they were fortunate in having even so slight an increase in the revenue. The traffic from the 1st of January of the present year showed satisfactory results, in fact, it was pretty well up to the average of the previous two years, and therefore if there was no great falling off in the next nine months he thought that they might have pretty much the same satisfactory accounts to present at the next meeting. The working expenses for 1913 showed an increase of £1,158. It was in the salaries at the stations where the advance had taken place, owing to a revision of salaries which the directors considered it just to make and which came into force on July, 1st, 1912. That revision, including the normal increases which would have taken place had meant an addition of £1,170 to the salaries of the operating staff. The balance of the £33,000 which they expended in 1911 on the partial renewal of the Bilbao cable, disappeared from the accounts as they had taken £8,168, which was the balance left over, out of the reserve. The Bilbao cable was interrupted on the 3rd October last and was repaired on the 14th of the same month, so that the interruption only lasted for 12 days. The cost of the repairs, £2,506, had been charged against revenue account. The £30,000 4½ per cent. debenture stock, issued 20 years ago, was repayable on 30th June next, and £29,024 had been put aside for that purpose—£800 of the debentures having already been purchased and cancelled some time ago.

Sir A. J. Leppoc Cappel, K.C.I.E., seconded the motion and the report was adopted.

Mackay Companies.

The accounts published by the Mackay Companies give the following particulars:—

Income from investments in other companies...		$4,202,413.30
Disbursements:—		
Dividends on preferred shares ...	$2,000,000	
" common shares ...	2,069,020	
Operating expenses, including transfer agents, registrars, auditors' and trustees' compensation, office rent, salaries, stationery, engraving of certificates, &c.	30,587.70	
Balance carried forward	102,805.60	$4,202,413.30

Balance-Sheet.

Assets:—

Investments in other companies		$91,997,714.19
Cash		471,995.31
		$92,469,709.50

Liabilities:—

Preferred shares issued	$50,000,000	
Common " "	41,380,400	
Surplus	1,089,309.50	$92,469,709.50

Automatic Telephone Manufacturing Co., Ltd.

Mr. James Taylor presided over the second ordinary general meeting held in Liverpool on Monday.

In moving the adoption of the report and balance-sheet, the Chairman said the profit for the year amounted to £24,166, an increase over the previous year of £10,668, which under all the circumstances, the directors considered satisfactory. The directors' faith in the future of the automatic telephone had, if anything, been strengthened during the year's operations. The amount of actual automatic work completed had, however, been disappointing. The number of orders received had been quite satisfactory, but the company had not been able to complete any substantial amount of the work for the reason that the purchasers had not been ready to take delivery. In addition to the above, the company had orders from the British Post Office for automatic exchanges for Newport (Mon.), Portsmouth, Paisley, Chepstow and Accrington. Once that initial delay, which was beyond their control, had been overcome, the orders in hand and others, that it was confidently expected would be obtained in the near future, would follow in regular sequence through the factory. Several small automatic exchanges for commercial undertakings in this country had been supplied, and were giving satisfaction. A good commencement had been made with business abroad. The sum of £18,183 had been spent on capital account during the year, this being for additions to the factory and offices to cope with the increased business they expected in automatic telephone equipment in the near future. Altogether the directors felt that the prospects of the company for the future were brighter than the results shown by last year's working would appear to indicate.—Mr. D. Sinclair, who seconded, said that they had on their books very good orders indeed, and the automatic system had not disappointed them in the slightest degree. From a commercial point of view they knew that Government departments, built, managed, and exercised as they were, were of necessity slower than some other commercial departments, and they had to submit and wait as shareholders, because the Government were the only important buyer in the country, and, as they were the Government, the company had to comply with the conditions which existed. There was nothing wrong with the conditions except perhaps that the Government were a little slower than some of them would like to see. The motion was unanimously carried.

South Metropolitan Electric Trams and Lighting Co., Ltd.—The directors report that the total revenue for 1913 was £63,135, compared with £61,944 for the preceding year. After deducting expenses, payments to local authorities under agreements, interest on debenture stock, and setting aside £3,000 to the renewals fund, there remains a surplus of £15,026. It is proposed to place to reserve £5,000, to pay a dividend of 6 per cent. on the preference shares, £10,174, carrying forward £775. The *Financier* states that the gross receipts from the tramways and light railways amounted to £45,443, an increase of £301. The company's motor-omnibuses commenced running in August, and the net receipts therefrom amounted to £1,035. The gross receipts from the electricity supply section (including the sale of energy to the tramways) amounted to £15,694, as compared with £14,124 for 1912. The total units sold during the year, including 198.697 supplied to the tramways, were 1,034.061, as compared with 920,316 in 1912. The units sold for lighting and power purposes were 835,364, an increase of 107,784 units. The number of consumers at December 31st last was 1,759, as compared with 1,535.

Crompton & Co., Ltd.—The *Times* reports that a meeting of the debenture-holders of Crompton & Co. was held on Monday by order of the Court, at which the proposed scheme of arrangement was passed by a large majority. The debenture interest will be raised from 5 per cent. to 5½ per cent.

Urban Electric Supply Co., Lt.

The directors report that for the year ended December 31st, 1913, the gross profits amount to £64,895, as compared with £57,466 a year ago, and after deducting the expenses shown in the profit and loss account, a balance of £61,684 is carried down to net profit and loss account. In the latter account the amounts required for interest and debenture stock redemption absorb £39,659, leaving an available balance, including the sum of £996 brought forward, of £23,021, which the directors recommend should be applied as follows:—To reserve for depreciation, £12,000; to dividend of 4 per cent. for the year on the preference shares, £10,000; to balance to be carried forward, £1,021. The balance of the 5 per cent. dividend on the preference shares will be satisfied by funded dividend certificates in accordance with the terms of the resolution passed and confirmed at the extraordinary general meetings held on February 2nd and 17th, 1912. The following table shows the equivalent in 33-watt lamps connected, and the gross profits, at December 31st of each year:—

	1911.	1912.	1913.	1911.	1912.	1913.
Hawick	65,599	70,251	76,964	£4,840	£4,788	£4,959
Stamford	32,411	34,515	40,561	1,467	1,529	2,004
Weybridge and Walton	66,136	71,862	78,725	6 040	5,963	5,881
Godalming	32,271	25,518	37,759	3,396	3,416	3,443
Twickenham and district	113,068	129,466	146,462	10,959	11,012	12,129
Dartmouth	24,543	25,274	26,589	2,637	2,410	2,171
Camborne and Redruth and Cornwall	105,178	146,954	179,088	8,727	13,869	19,657
Newton Abbot	20,719	22,761	24,950	1,695	2,003	2,259
Grantham	39,209	40,586	42,902	2,648	3,132	3,182
Glossop	28,782	33,125	35,422	2,988	2,898	2,651
Berwick	21,683	23,881	24,958	1,565	1,615	1,728
Caterham	16,563	18,426	19,916	1,635	1,927	2,074
Newbury	23,575	24,926	26,423	2,259	2,873	2,746
Total	569,737	677,495	760,819	£50,850	£57,436	£64,871
	Lamps.			Gross profits.		

The meeting is called for April 1st.

Shawinigan Water and Power Co.—For 1913 the directors show that the increase in gross income is $121,211. With the completion of the addition to the two plants at Shawinigan Falls, now under construction (says the *Financial Times*), there will have been made the largest single increase in capacity ever undertaken by the company. This installation consists of three additional units of a total capacity of 45,000 H.P. A second transmission line of the steel tower type has also been built to Three Rivers, which city continues to develop as a market for power. The net earnings amounted to $1,473,400, out of which dividends amounting to 6 per cent. have been paid; there has been transferred to reserve and sinking funds, $206,483; to contingent fund, $10,000; to depreciation reserve, $100,000; leaving a balance at credit of profit and loss of $19,878.

Companies Struck Off the Register.—The following companies have been struck off the Register, and are accordingly dissolved:—

Auto Conveyors.
British Electrics (Moseley's Patents).
British Patent Tube Cleaning Syndicate.
Davies Patent Boiler.
Ecco Battery and Electrical Co.
Electromuse.
Hunslet Electrical Pottery Co.
Madeira Electric Lighting Co.
Mutual Electricity Supply Co.
Premier Electric Lamp Co.
Simplex Arc Lamp Syndicate.
Westminster Automatic Telephone Syndicate.

Minehead Electric Supply Co., Ltd.—Mr. H. D. Leather presided at the annual meeting. He said that they had had a very satisfactory year with an advance from 181,417 to 212,969 units, and an increase from £2,893 to £3,257 in income. The works costs per unit were ·93d., a decrease of 15 per cent. The increase in revenue was mainly due to heating and cooking. They proposed to adopt a new system of charging based on the rateable value of the premises supplied. The speaker referred to the excellent services of Mr. Swarbrick, the engineer and manager, and of the employés. The report was adopted.

Richardsons, Westgarth & Co., Ltd.—The directors' report for 1913 shows a definite improvement but unfavourably affected by the delay in completing the contracts taken before the trade boom set in. The steam turbine department is well supplied with work, including two land units of 18,000 and 15,000 H.P. respectively, which are among the largest in the country, also a marine geared-turbine twin-screw set of 6,000 H.P. The position generally is more favourable than for several years past, and, given normal labour conditions, a continuation of the improvement shown in the year under review is reasonably assured.

Continental.—France.—A new company has lately been formed at Chatelard (Savoy), with a capital of £6,000, and the title La Société d'Eclairage Electrique et de Forces Motrices des Beauges, to put down a plant to utilise the water power of the River Cheran in the generation of electrical energy for lighting and power purposes to a number of small towns in the district.

Switzerland.—The Oerlikon Akkumulatorenfabrik Gesellschaft is declaring a dividend of 20 per cent. for the last financial year, the same as for the preceding twelve months.

American Telephone and Telegraph Co.—For 1913 the net earnings were $40,576,746, an increase of $2,669,102 over 1912. Interest charges were $7,656,656 and the dividends at the regular rate of 8 per cent. were $27,454,037. Of the balance, $5,466,053, there was carried to reserves $2,500,000 and to surplus $2,966,053. The directors say: "The proprietors of the company should rest quietly, and not be scared or frightened into sacrifices of their securities. Whether Government purchase be ultimately decided upon or not, the property is well worth more than the market price of its securities. This is not mere assertion, it is an established fact. Friendly and unfriendly appraisals of the various properties have been made; in no instance has the appraised value been placed below the book value, while in most instances it has been placed in excess."—*Financial News.*

Cleveland and Durham Electric Power Co.—In the report for six months to December last capital expenditure on works is stated (according to an abstract in the *Financial News*) to have been £14,500 and gross profits, including dividend receivable from Cleveland and Durham County Electric Power Co. for 1913 of £18,900, amount to £25,700. After providing for debenture and other interest there remains £16,175, plus the amount brought forward, making £18,641. It is proposed to pay 5 per cent. dividend on preference shares, to transfer to depreciation and renewals account £1,000, to reduce expenses of issue of debentures by £500, and carry forward £8,798. Connections to the company's system at December 31st increased by 3,700 H.P. during the six months, and a further 12,500 H.P. has been arranged for.

Wedmore Electric Light and Power Co.—At the annual meeting held last week, the managing director, Mr. W. G. Burrough, in the chair, shareholders expressed complete satisfaction with the manner in which the affairs of the company had been carried on. various extensions having been made in lighting the villages of Theale and Blackford. A dividend of 5 per cent. was paid.

Weaverham (Northwich) Electric Supply Co.—According to a financial daily a dividend of 5 per cent. on the ordinary shares is announced. After writing 20 per cent. off preliminary expenses and providing for depreciation, £45 is carried forward. Revenue from sale of electricity has increased by 80 per cent., and the area is being extended to include Sandiway and Buddington villages. Overhead distribution is employed.

South Staffordshire Tramways Co., Ltd.—The annual meeting was held on Monday. Mr. S. R. Blundstone, who presided, said that the income for the year was £3,546. After meeting expenses and writing off depreciation on investments, a dividend of 3½ per cent. was to be paid on the preference shares.

Stock Exchange Notices.—The Committee has ordered the following to be quoted in the Official List:—

Buenos Ayres Lacroze Tramways Co.—£500,000 5 per cent. con. mort. debs. of £100, Nos. 5,001 to 10,000, in lieu of scrip.

Vancouver Power Co., Ltd.—Further issue of £660,000 4½ per cent. perp. guar. deb. stock.

Browett, Lindley & Co., Ltd.—A financial daily states that after providing for interest charges and writing off £5,062 for depreciation, the accounts for 1913 show a net profit of £3,661, reducing the debit balance of £17,562 brought forward to £13,901.

Lancashire Dynamo and Motor Co., Ltd.—The directors have declared a dividend at the rate of 10 per cent. per annum on the ordinary shares, making 8 per cent. for the year 1913.

Alldays & Onions Pneumatic Engineering Co., Ltd.—An interim dividend at the rate of 5 per cent. per annum on the ordinary shares is recommended for the past half-year.

STOCKS AND SHARES.

Tuesday Evening.

With prices in the Stock Exchange so dependent upon the political situation, and with the sentiment swaying from day to day, what is written on Tuesday night may have the appearance of something akin to nonsense on Friday morning. The financial paragraphist, always alive to this responsibility, feels more than ever that he must tread circumspectly in such conditions as now obtain. For depression and buoyancy follow so quickly upon one another's heels, even in the course of an hour or two, that the strength of markets this evening may be shattered before this appears printedly.

The Stock Exchange settlement just concluded found plenty of money available for employment, and this being so at the end of the quarter, it may be taken as conclusive testimony to the amount of capital awaiting investment so soon as political conditions permit of a rise in the Stock Exchange markets. Inquiries made in person throughout some of the provincial centres afford equally conclusive evidence of the willingness to invest, and the ability to do so, on the part of a large section of the public which is shaping its course according to the events in Westminster and Ulster. That trade is less buoyant than it was a little while ago, few people deny, but that there are plenty of orders still going, is admitted in the same breath.

Last week's new issues left underwriters in some cases with substantial proportions of their obligations. The London and Suburban Traction Debenture issue was taken up to the extent of only about 6 per cent. by the public. The Toronto Power Company's offer of Debenture stock also left the public cold, underwriters being saddled with something like 80 per cent., and the price of the latter scrip is quoted at 2½ discount, while the London and Suburban Debenture dropped to 6 discount upon the issue price of 92. Probably enough, however, the underwriters will find homes for both securities in course of time; and although the stream of new issues has been checked to some extent, there are appeals being prepared for the public, the advent of which may be expected before long. For instance, we understand that the General Electric Company is about to take powers to issue substantial amounts of new Ordinary and new Preference shares.

The County of London new shares have been quoted about 2s. premium, this being considerably below what they would probably have been started at in the market, had it not been that proprietors were offered the opportunity of subscribing for more shares than they were entitled to in virtue of their existing holdings. This being the case, of course neither shareholders nor jobbers were anxious to buy shares in the market when there was a chance of their being able to get them at the issue prices from the company. After the allotments, no doubt fairer premiums will develop.

Bournemouth and Poole shares have again risen, because of the scarcity of the supply and the fact that there are one or two buyers about. But the market for Electricity Supply shares as a whole is somewhat dull. Cities, Counties and St. James have all gone back. Westminster Preference regained their ⅛ decline. The heated controversy which has arisen as to the scheme in connection with the holding company has had the effect of keeping people away from the market, rather than encouraging them to acquire fresh interests; so that until something definite is settled, we scarcely look for any particular movement in prices. The passage of the County of London's Bill would illuminate the situation not a little; whether it will go through or not seems to be regarded as a matter of great speculation.

The Urban Company has done well, and, on the good results now announced, the price of the Preference shares hardened to 3.

Affairs in Mexico are at this moment considered to be tending towards some unravelment of the tangled skein of domestic politics over there, and it is stated that the United States Government has at length sent a representative to treat with General Huerta, with the idea of evolving some sort of order out of the chaotic conditions too long prevalent. On the hope that the mission might be successful, most stocks and shares connected with Mexico experienced substantial recoveries, the railway stocks being prominent in the rise, followed at a more respectful distance by the securities connected with the utility concerns. These last had some fresh cause for anxiety in the threat made at the end of last week to dispossess the Mexican Light and Power Company of its concessions—a threat that was promptly denied.

Mexican Light and Power Common have gained a point, but the 5 per cent. First Mortgage Gold bonds are easier, being now quoted at almost the same price as the company's 7 per cent. Cumulative Preference shares. Mexico Trams Common are 4 points higher, but, oddly enough, both issues of the bonds have fallen. Declines in Rio Tramway First and Second bonds did not amount to much. Brazil Tractions slumped at one time to 79½, from which there has been a smart recovery to 82, leaving the shares 1½ down on the week. Para Electric Railways Ordinary lost ½, and most of the markets connected in any way with Brazil have been dull, with a better tendency on Tuesday.

Anglo-Argentine Tramways First Preference shed ½, which brings the return on the money to over 5¾ per cent., the shares now obtainable at a small discount. British Columbia Deferred rose 2, this market, as a whole, being steady. Toronto Power 4½ per cent. Debenture fell 2½ upon the result of the company's offer of stock, mentioned above. La Plata Tramways are slightly easier.

Home Railway stocks, after a bout of flatness, hardened substantially at the beginning of the week. Comparatively little stock changed hands, and sentiment was largely responsible for putting up prices hand-over-fist. Metropolitans are 2 up, but the Surplus Lands stock is again a point lower. Underground Electric Income bonds gained 1½. Districts are steady at 29, having been 27½. London and Suburban Traction issues are unchanged, but London United Tramways 4 per cent. Debenture stock dropped 3 to 62, the offer of a small amount finding the market by no means anxious to take it.

Changes in the Telegraph and Telephone list are not exciting. Amazons dropped ½ to 6. Small declines took place in Anglo-American Deferred, Eastern Ordinary and West India and Panama shares. Westerns retained their rise at 13½, at which they stand just £1 higher than Eastern Extensions, the dividends on both being 7 per cent. The Eastern Extension position is a thoroughly sound one, and an exchange from one into the other would give an increase of about 7s. 6d. per cent. in the return. Oriental Telephones have hardened. Marconis went back in the general depression, but rallied from their loss. Reuters are weak at 8½. Telegraph Constructions at 38 are 10s. down. Of the manufacturing list, British Insulateds are strong, with a 5s. advance, and British Westinghouse 4 per cent. Debenture went up 2. British Aluminiums are the turn easier.

Rubber again rose to half-a-crown per lb., and the Mincing Lane auctions this week have been satisfactory to the sellers. Rubber share prices show moderate improvements, but in this section, as in so many others, public interest has been smothered by Ulster.

SHARE LIST OF ELECTRICAL COMPANIES.

ELECTRIC RAILWAYS AND TRAMWAYS.—HOME.

NAME.	Stock or Share.	Dividends for 1912.	Dividends for 1913.	Closing Quotations March 24th.	Rise + or Fall —	Present Yield p.c. £ s. d.
Bath Trams, Pref. Ord.	* 1	Nil	..	⅜ — ⅝	..	Nil
Do. 5 % Pref.	1	5	5	1 — 1⅛	..	6 13 4
Do. 4½ % Deb.	100	4½	4½	70 — 75	..	6 0 0
Brit. Elec. Trac., 6 % Pref.	100	..	..	15½ — 17½	..	..
Do. Do. Deferred	100	..	..	6½ — 8½	..	..
Do. Do. 6 % Cum. Pr'f.	100	6	6	89 — 92	..	6 10 5
Do. 7 % Non-Cum. Pr'f.	100	8	..	56 — 59	..	5 1 8
Do. 5 % Perp. Deb.	100	5	5	96 — 99	+1	5 1 0
Do. 4½ % 2nd Deb.	100	4½	4½	80 — 83	..	5 8 5
Central London Railway, Ord.	100	8	8	57 — 62	..	4 16 9
Do. Gtd. Assented	100	..	4	80 — 82	..	4 17 5
Do. Pref.	100	4	4	68 — 73	..	5 9 7
Do. Gtd. Assented	100	..	4	82 — 84	..	4 15 2
Do. Def.	100	2	2	57 — 62	..	3 4 6
Do. Gtd. Assented	100	..	4	79 — 81	..	4 18 7
Do. 4 % Deb.	100	4	4	97 — 99	..	4 0 10
City & S. London, 5 % Pref., 1891	100	5	5	95 — 97	..	5 3 1
Do. Do. 1898	100	5	5	93 — 96	−1½	5 4 2
Do. Do. 1901	100	5	5	9 — 92	..	5 8 8
Do. Do. 1908	100	5	5	89 — 92	..	5 8 8
Do. 4 % Deb.	100	4	4	88 — 90	..	4 9 0
Hastings Trams, 6 % Pref.	1	6	6†	¼ — ⅜	..	8 0 0
Do. 4½ % Deb.	100	4½	4½	67 — 72	..	6 5 0
Isle of Thanet Trams, 5 % Pref.	5	2½	3	2 — 2½	..	6 0 0
Do. 4 % Deb.	100	4	4	71 — 76	..	5 5 3
Lancashire United, 5 % Deb.	100	5	5	87 — 89	+1	5 12 4
London and Suburban, Ord.	1	..	..	3/32 — 5/32	..	..
Do. Do. 5 % Cum. Pref.	1	..	5†	⅛ — ¼	..	6 18 4
Do. Do. 4½ % 1st Deb.	100	4½	4½	79 — 84	..	5 7 2
London Elec. Railways, 4 % Deb.	* 100	1912. 4	1913. 4	89 — 91	..	£ s. d. 4 7 11
London United Trams, 4 % Deb.	100	4	4	60 — 64	−3	6 5 0
Metropolitan Railway Consol.	100	1⅝	1⅝	42⅜ — 43¼	+2	3 15 2
Do. Surplus Lands	100	2⅜	2⅜	61 — 63	−1	4 7 4
Do. 3½ % Deb.	100	3½	3½	87 — 89	..	3 18 7
Do. 3½ % Pref.	100	3½	3½	82 — 84	..	4 3 4
Do. 3½ % Con. Pref.	100	3½	3½	80 — 82	..	4 5 4
Metropolitan District Ord.	100	Nil	..	28⅜ — 29½	+ ⅜	Nil
Do. 6 % Deb.	100	6	6	138 — 141	..	4 5 1
Do. 4 % Deb.	100	4	4	93 — 95	..	4 4 3
Do. 4 % Prior Lien	100	4	4	97 — 99	..	4 0 10
Do. 4½ % First Pref.	100	4½	4½	85 — 88	..	5 2 2
Do. 3½ % Gtd.	100	3½	3½	74 — 76	..	4 12 1
Metro. Elec. Trams, 4½ % Deb.	100	4½	4½	89 — 92	..	4 17 9
Do. 5 % Deb.	100	5	5	88 — 91	..	5 10 0
Potteries, Ord.	1	3¼	..	⅛ — ¼	..	..
Do. 5 % Pref.	1	5	5	⅛ — ¼	..	7 12 8
Do. 4½ % Deb.	100	4½	4½	84 — 87	..	5 3 6
South Metro. Trams, 6 % Pref.	1	6	6†	⅜ — ½	..	8 0 0
Do. 4 % Deb.	100	4	4	66 — 70	..	5 14 4
Underground Elec. Railways	10	..	..	3 — 3⅛	..	Nil
Do. "A"	1/-	..	..	1/32 — 1/16	..	Nil
Do. 6 % First Cum. Inc. Deb.	100	6	6	112 — 114	..	5 5 3
Do. 4½ % Bonds	100	4½	4½	99 — 101	..	4 9 0
Do. 6 % Income	100	6	6	89½ — 90½	+1½	6 12 7
Yorkshire (West Riding). Ord.	5	Nil	..	1/16 — 1/8	..	Nil
Do. 6 % Pref.	5	3	4	4 — 4½	..	4 9 0
Do. 4½ % Deb.	100	4½	4½	88 — 86	..	5 4 8

ELECTRIC RAILWAYS AND TRAMWAYS.—COLONIAL AND FOREIGN.

Anglo-Arg. Trams, 1st Pref.	5	5½	5½	4¹¹/₁₆ — 5¹/₁₆	— ⅛	5 17 4
Do. 2nd Pref.	5	5½	5½	4⅞ — 4¹⅞	..	6 0 7
Do. 4 % Deb.	100	4	4	92½ — 94½	..	4 4 8
Do. 4½ % Deb.	100	4½	4½	97 —100	..	4 10 0
Do. 5 % Deb.	100	5	5	96½ — 98½	..	5 1 6
Auckland Trams, 5 % Deb.	100	5	5	108 —106	..	4 14 3
Bombay Elec. S. & Trams, Pref.	10	6	6	10⅞ — 11½	..	5 4 4
Do. 4½ % Deb.	100	4½	4½	94½ — 96½	..	4 13 3
Do. 5 % 2nd Deb.	100	5	5	98 —100	..	5 0 0
Brazilian Traction, Light and Power	$100	6	6†	81 — 83	−1½	7 4 7
Brisbane Trams Invt., Ord.	5	8	8	7⅜ — 8¼	..	4 18 6
Do. 5 % Pref.	5	5	5	4¼ — 5⅛	..	4 13 0
Do. 4½ % Deb.	100	4½	4½	98 —101	..	4 9 1
B. Columbia Elec. Rly., Def.	100	8	8†	115 —119	+2	6 14 6
Do. Pref. Ord.	100	6	6	104 —108	−1	5 11 1
Do. 5 % Pref.	100	5	5	100 —103	−1	4 17 2
Do. 4½ % 1st Mort. Deb.	40	4½	4½	98 —101	..	4 9 1
Do. 4½ % Vancouver Deb.	100	4½	4½	94 — 98	..	4 12 0
Do. 4½ % Con. Deb.	100	4½	4½	94 — 96	+ ½	4 8 7
Calcutta Trams, Ord.	5	7½	5†	6¼ — 6⅝	..	5 11 1
Do. 5 % Pref.	5	5	5	5 — 5⅛	..	4 15 3
Do. 4½ % Deb.	100	4½	4½	96 — 99	..	4 11 0
Cape Electric Trams	1	5	5	⅜ — ½	..	6 18 4
City Buenos Aires Trams (1904)	5	5	5	5¼ — 5⅜	..	4 10 11
Do. 4 % Deb.	100	4	4	91 — 96	..	4 8 4
Colombo Elec. Tr. & Lt., 5 % Deb.	100	5	5	89 — 93	..	5 7 8
Havana Elec. Rly., 5 % Bonds	$1000	5	5	93½ — 97⅛	..	5 2 6
Kalgoorlie Elec. Trams	1	Nil	..	0 — 1/16	..	Nil
Do. 5 % A Deb.	100	5	5	85 — 90	..	5 11 1
Do. 6 % B Deb.	100	3	..	10 — 20	..	Nil
La Plata Elec. Trams, Ord.	1	..	..	1/32 — 1/16	−1/16	..
Do. Pref.	1	4½d.	6	1/32 — 1/16	..	6 0
Lisbon Elec. Trams, Ord.	1	6	6†	1⅛ — 1⅜	..	4 7 8
Do. 6 % Pref.	1	6	6	1⅛ — 1⅜	..	5 1 0
Do. 5 % Deb.	100	5	5	91 — 96	..	5 4 2
Madras Elec. Tr., 6% Cum. Pref.	5	6	6	5 — 5⅜	..	5 11 7
,, Elec. Tr. (1904), Deb.	100	5	5	101 —103	..	4 17 0
Manaos Trams & Lt., 1st Deb.	100	5	5	79 — 82	..	6 2 0
Manila Elec. R. and Ltg., Bonds	$1000	5	5	98½ —100½	..	4 19 6
Mexico Trams Com	$100	7	7	73 — 76	+4	..
Do. Gen. Con. 5 % Bonds	..	5	5	78 — 82	−2	6 2 0
Do. 6 % Bonds	100	6	6	75 — 79	−6	7 12 0
Para Elec. Rlys. & Lt., Ord.	5	10	10	4⅜ — 4¾	— ⅛	10 5 2
Do. 6 % Pref.	5	6	6	4⅛ — 4⅜	..	6 9 9
Do. 5 % 1st Deb.	100	5	5	92 — 94	..	5 6 5
Rangoon El. Tr. & Sup., Pref.	5	6	6	5 — 5¼	..	5 9 1
Do. 4½ % 1st Deb.	100	4½	4½	95 — 97	..	4 12 9
Rio de Janeiro Trams, 1st Mort. & 5 % Bonds	..	5	5	94 — 96	−1	5 4 0
Do. 5 % Mort. Bonds	100	5	5	87 — 89	..	5 12 5
Sao Paulo Tram., Lt. and P. & 5 % 1st Deb.	$500	5	5	97 —100	+1	5 0 0
Singapore Trams, 5 % Deb.	100	5	5	88 — 92	..	5 8 8
Southern El. Tr. B.A., 5 % Deb.	100	5	5	95 — 97	..	5 3 0
Un. Elec. Trams Monte Video	5	7	7	4⅜ — 5⅛	..	6 16 7
Do. 6 % Pref.	5	6	6	4⅜ — 5⅛	..	5 14 3
Do. 5 % 1st Deb.	100	5	5	95 — 98	..	5 2 0
Winnipeg Elec. Rly., 4½ % Deb.	100	4½	4½	93½ — 95½	+ ½	4 14 3

ELECTRICITY SUPPLY AND POWER COMPANIES.—HOME.

Bournemouth & Poole, Ord.	10	6	7	10¾ — 11¼	+ ¼	6 4 4
Do. 4½ % Pref.	10	4½	4½	9 — 10	+ ⅛	4 10 0
Do. Second 6 % Pref.	10	6	6	10¼ — 10¾	+ ¼	5 11 7
Do. 4½ % Deb. Stock	Stock	4½	4½	94 — 97	..	4 12 9
Brompton & Kensington, Ord.	5	10	10†	9 — 9¼	..	5 4 0
Do. 7 % Cum. Pref.	5	7	7	8⅞ — 9¼	..	3 16 9
Central Electric Supply, 4 % Guar. Deb.	100	4	4	91½ — 94½	..	4 4 8
Charing Cross, West End & City	5	5	6	4⅛ — 5	−1/16	6 0 0
Do. 4½ % Cum. Pref.	5	4½	4½	4⅜ — 4⅝	..	4 12 4
Do. "City Undertaking" 4½ % Cum. Pref.	5	4½	4½	3⅞ — 4⅛	..	5 2 10
Do. Do. 4 % Deb.	100	4	4	92 — 94	..	4 5 1
Chelsea, Ord.	5	5	5	4⅛ — 5⅛	..	4 18 0
Do. 4½ % Deb.	Stock	4½	4½	97 — 100	..	4 10 0
City of London, Ord.	10	9	10	17 — 18	— ½	5 11 1
Do. 6 % Cum. Pref.	10	6	6	12⅜ — 13⅛	..	4 7 3
Do. 5 % Deb.	Stock	5	5	116 — 120	..	4 7 4
Do. 4½ % Second Deb.	100	4½	4½	100 — 103	..	4 8 1
County of London, Ord.	10	6	7	12 — 12½	— ⅛	5 12 8
Do. 6 % Pref.	10	6	6	11⅝ — 12⅛	— ⅛	4 19 0
Do. 4½ % Deb.	Stock	4½	4½	102½ — 105½	— ½	4 5 9
Do. 4½ % Second Deb.	Stock	4½	4½	100 — 103	..	4 7 5
Edmundson's, Ord.	£3	..	..	3/32 — 1/8	..	Nil
Do. 6 % Cum. Pref.	5	6	6	5⅞ — 6⅛	..	7 1 2
Do. 6 % Non-Cum. Pref.	5	..	..	1⅞ — 2	..	..
Do. 4½ % First Mort. Deb.	100	4½	4½	84 — 87	..	5 3 6
Folkestone	5	6	6	4¼ — 5	..	6 0 0
Do. 5 % Cum. Pref.	5	5	5	4⅛ — 4⅞	..	5 2 7
Do. 4½ % First Deb.	100	4½	4½	93 —	..	4 14 9
Hove	5	8	9	8¼ — 9	..	5 0 0
Kensington & Knightsbridge, Ord.	5	8	9	7¾ — 8	..	5 12 6
Do 4 % Deb.	Stock	4	4	90 — 92	..	4 7 0
Kent Elec. Power, 4½ % Deb.	Stock	4½	4½	76 — 80	..	5 12 0
London Electric, Ord.	3	2½	3	1⅞ — 1⅛	..	4 12 8
Do. 6 % Pref.	5	6	6	4⅞ — 5¼	..	5 14 3
Do. 4 % First Mort. Deb.	Stock	4	4	91 — 94	..	4 5 1
Metropolitan	5	4½	4½	3¾ — 4	..	5 5 3
Do. 4½ % Cum. Pref.	5	4½	4½	4⅜ — 5	..	4 10 0
Do. 4½ % First Mort. Deb.	Stock	4½	4½	97 — 100	..	4 10 0
Do. 3½ % Mort Deb.	Stock	3½	3½	83 — 86	..	4 1 4
North Metropolitan Power Supply, 5 % Mortgages (Red.)	100	5	5	100 — 103	..	4 17 1
Notting Hill, 6 % Non-Cum. Pref.	10	6	6	9⅞ — 10⅛	..	5 14 3
Oxford	5	7	7	6⅛ — 6⅝	..	5 11 0
St. James' and Pall Mall, Ord.	5	10	12	9⅜ — 9½	— ⅛	6 1 6
Do. 7 % Pref	5	7	7	6¾ — 7 xd	..	5 0 0
Do. 3½ % Deb.	100	3½	3½	82 — 85	..	4 2 4
South London, Ord.	4	5½	5½	3 — 3⅜	..	6 10 4
Do. 5 % First Mort. Deb.	100	5	5	98 — 101	..	4 19 0
South Metropolitan, 7 % Pref.	1	7	7	1⅜ — 1⅝	..	5 9 2
Do. 4½ % First Deb. Stock	100	4½	4½	97 — 100	..	4 10 0
Urban, Ord.	£3	Nil	..	1/32 — 1/16	..	..
Do. 5 % Cum Pref.	5	3‡	4	2¼ — 3¼	+ ⅛	6 3 1
Do. 4½ % First Mort. Deb.	100	4½	4½	86 — 89	..	5 1 3
Westminster, Ord.	5	10	10	8¾ — 9	..	5 11
Do. 4½ % Cum Pref.	5	4½	4½	5¹/₁₆ — 5⅛	+1/16	4 4 9

* Unless otherwise stated, all shares are fully paid. † Interim Dividend. ‡ 3s. Cash and 2% in Funded Certs.

Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—*(Continued.)*

ELECTRICITY SUPPLY AND POWER—COLONIAL AND FOREIGN.

NAME.	Stock or Share.	Dividends for		Closing Quotations March 24th.	Rise + or Fall —	Present Yield p.c.
						£ s. d.
Adelaide, 6 % Pref.	£5	6	6	5 — 5½	..	5 14 3
Calcutta, Ord.	£5	8½	5†	7⅞ — 8	..	5 6 3
Do. 5 % Pref.	£5	5	5	5⅛ — 5⅜	..	4 18 0
Calgary Power, 1st Mort. Bds.	100	5	5	90 — 92	..	5 8 8
Canadian Gen. El. Com.	$100	7	8	113 —117	..	6 16 9
Do. 7 % Pref.	$100	7	7	123 —128	..	5 9 5
Cordoba Lt., Power and T., Ord.	£1	5	..	7/16 — ⅜	..	7 12 0
Do. 5 % Deb.	100	5	5	90 — 93	..	5 7 6
Elec. Lt. and P. of Cochabamba, 6 % Bonds	100	6	6	88 — 90	..	6 13 4
Elec. Supply Victoria, 5 % 1st Mort. Deb.	100	5	5	91 — 94	..	5 5 5
Elec. Dev. Ontario, 5 % 1st Mort. Bonds	$500	5	5	93 — 95	..	5 5 3
Kalgoorlie Elec. P. and L., Ord.	10/-	Nil	..	⅛ — ¼	..	Nil
Do. 6 % Pref.	£1	6	6†	11/16 — ¾	..	10 11 10
Kaministiquia Power, 5 % G. Bs.	$500	5	5	102 —104	..	4 16 2
Madras, Ord.	£5	Nil	..	1⅛ — 1⅜	..	..
Melbourne, 5 % 1st Mort. Deb.	100	5	5	103¾—106¾	..	4 14 0
Mexican El. Lt., 5 % 1st M. Bds.	..	5	5	65 — 70	—2	7 2 10
Mexican Lt. & Power, Common	$100	4	4†	41 — 44	+1	..
Do. 7 % Cum. Pref.	$100	7	7	78 — 82	..	8 10 8
Do. 5 % 1st Mort. Gold Bds.	..	5	5	78 — 80	—3	6 5 0
Do. 5 % 2nd Mort. Bonds	100	5	5	65 — 69	..	7 4 11

NAME.	Stock or Share.	Dividends for		Closing Quotations March 24th.	Rise + or Fall —	Present Yield p.c.
	*	1912.	1913.			£ s. d.
Monterey Rly., Light & Power, 5 % 1st Mort. Deb.	100	5	5	54 — 59	..	..
Montreal, Lt., H. and Power	$100	9	10†	230 —235	..	4 5 0
Northern, Lt., Power and Coal, 5 % 1st Mort. Bonds	$500	5a	5a	10 — 20	..	..
River Plate, Ord.	Stock	10	..	235 —245	..	4 1 8
Do. 6 % Non-Cum. Pref.	Do.	6	6	103 —108	..	5 11 1
Do. 5 % Deb. Stock	Do.	5	5	101 —103	..	4 17 0
Roy. Elec. Co., Montreal, 4½ % 1st Mort. Deb.	100	4½	4½	102 —104	..	4 6 7
Shawinigan Water, Capital	$100	5½	6†	138 —142	..	4 4 6
Do. 5 % Con. 1st Mort. Bonds	$500	5	5	107 —109	..	4 11 7
Do. 4½ % Per. Deb.	Stock	4½	4½	100 —102	..	4 8 8
Toronto Power, 4½ % Deb.	Do.	4½	4½	94 — 96	—2½	4 13 9
Vera Cruz Lt., P. and T., 5 % 1st Mort. Deb.	100	5	5	88 — 90	..	5 11 1
Victoria Falls Power, Pref.	£1	6	6	33/32 — 35/32	..	7 13 4
West Kootenay Power and Lt., 1st Mort. 6 % Gold	100	6	6	100 —102	..	5 17 8

MANUFACTURING COMPANIES.

Aron, Ord.	£1	7	..	33/32 — 37/32	..	8 5 0
Do. 6 % Pref.	£1	6	6	1 — 1⅛	..	5 17 2
Babcock & Wilcox	£1	16	14†	3⅝ — 3⅞	+3/32	4 17 6
Do. Pref.	£1	6	6	1 7/16 — 1 9/16	..	4 8 6
British Aluminium, Ord.	£1	..	..	1 1/32 — 1 1/16	—1/32	..
Do. 6 % Cum. Pref.	£1	6	6	1 — 1	+3/32	6 0 0
Do. 5 % Prior Liens Debs.	100	5	5	98 — 99	..	5 1 0
Do. Deb. Stk.	100	5	5	88 — 93	..	5 7 6
B.I. & Helsby Cables	£5	10	13	9½ — 10½	+ ½	6 6 10
Do. Pref.	£5	6	6	5½ — 6⅜	..	4 14 1
Do. Deb.	100	4½	4½	102 —105	..	4 5 9
British Thomson-Houston, Deb.	100	4½	4½	92 — 94	..	4 15 9
British Westinghouse, Pref.	£2	Nil	..	1 7/16 — 1 9/16	..	Nil
Do. Deb.	100	4	4	70½ — 72½	+2	5 10 6
Do. 6 % Prior Lien	100	6	6	102 —105	..	5 14 6
Browett, Lindley, Ord.	£1	..	..	2/- —3/-	..	Nil
Do. Pref.	£1	..	..	8/- —8/6	..	Nil
Brush, 7 % Pref.	£2	Nil	..	0 — ¼	..	Nil
Do. 5 % Prior Lien Deb.	100	5	5	80 — 85	..	5 17 8
Do. 4½ % Deb.	100	4½	4½	39 — 43	..	10 9 6
Do. 4½ % Second Deb.	100	4½	4½	26 — 27	..	16 18 4
Callender's Cable	£5	15	5†	11¼ — 12½	..	6 2 4
Do. Pref.	£5	5	5	4 13/16 — 5 3/16	..	4 16 5
Do. Deb.	100	4½	4½	97 —100	..	4 10 0
Castner-Kellner	£1	20	22½	2⅛ — 2⅜	..	..
Do. Deb.	100	4½	4½	104 —107	+1	4 4 1

NAME.	Stock or Share.	Dividends for		Closing Quotations March 24th.	Rise + or Fall —	Present Yield p.c.
Crompton & Co., Deb.	100	5	5	83 — 85	..	5 17 8
Dick, Kerr	£1	Nil	..	3/32 — 5/32	..	..
Do. Pref.	£1	6	6	3 1/32 — 3 3/32	..	7 2 2
Edison & Swan, A, £2 paid	£5	Nil	..	1/16 — 1/32	..	Nil
Do. fully paid	£5	Nil	..	1 — 1 1/32	..	Nil
Do. 4 % Deb.	100	4	4	58 — 62	..	6 9 1
Do. 5 % Second Deb.	100	5	5	63 — 68	..	7 7 1
Electric Construction	£1	5	..	3/32 — 5/32	..	7 12 6
Do. Pref.	£1	7	7	1/16 — 1 1/16	..	6 11 7
Greenwood & Batley, Pref.	£0	7	7	6½ — 7½	..	9 13 2
Do. Deb.	100	5	5	92 — 94	..	5 6 5
General Electric, 6 % Pref.	£0	6	6	10½ — 10¾	..	5 14 3
Do. Deb.	100	4	4	86 — 90	..	4 9 0
Henley's, Ord.	£5	15	20	18⅜ — 14½	..	6 17 11
Do. Pref.	£5	4½	4½	4½ — 5	..	4 10 0
Do. Deb.	100	4½	4½	101 —103	..	4 7 5
India-Rubber, G. & T.	£0	7½	7½	10½ — 11½	..	6 10 5
Do. Pref.	£0	5	5	8½ — 9½	..	5 5 3
Telegraph Construction	£2	20	20	37 — 39 xd	— ½	6 3 1
Do. Deb.	100	4	4	98 —100	..	4 0 0
Willans & Robinson, 4 % 1st Mort. Deb.	100	4	4	65 — 69	..	5 16 0
Do. B 4 % Cum. Pref.	100	..	..	50 — 55	..	..

TELEGRAPH AND TELEPHONE COMPANIES.

Amazon Telegraph	£10	4½	4½	5⅞ — 6¼	— ⅛	7 4 0
Do. 5 % Deb. Red.	Stock	5	5	94 — 97	.	5 3 0
American Telep. & Teleg., Cap.	$100	8	8	124 —127	+1	6 6 0
Do. Collat. Trust	$1000	4	4	91 — 94	..	4 5 3
Anglo-American Telegraph	Stock	3	3	64 — 67	..	4 9 7
Do. 6 % Pref.	Do.	6	6	108½—109½	..	5 9 4
Do. Def.	Do.	30/-	30/-	28½ — 24	— ½	6 5 0
Anglo-Portuguese Tel., 5 % Mort. Deb.	100	5	5	102 —104	..	4 16 2
Chili Telephone	£5	8	..	7⅜ — 7⅝	..	5 5 0
Commercial Cable, Stlg. 4 % Deb.	Stock	4	4	81½ — 83½	..	4 16 0
Cuba Telegraph	£10	6	6†	8⅜ — 9⅜	..	6 8 1
Do. 10 % Pref.	£10	10	10	15⅜ — 16⅞	..	5 19 5
Direct Spanish Telegraph, Ord.	£5	4	4	3½ — 4	..	5 0 0
Do. 10 % Cum. Pref.	£5	10	..	7½ — 8	..	6 5 0
Direct United States Cable	£10	4	4†	6⅞ — 7⅛	..	5 10 4
Direct W. India Cable, 4½ % Reg. Deb.	100	4½	4½	97 — 99	..	4 10 10
Eastern Telegraph, Ord. Stock	Stock	7	7	182 —185	—1	5 3 8
Do. 8½ % Pref. Stock	Do.	8½	8½	78 — 80	..	4 7 6
Do. 4 % Mort. Deb.	Do.	4	4	96 — 98	+1	4 1 8
Eastern Extension	£10	7	7	12⅜ — 12⅝	..	5 8 9
Do. 4 % Deb.	Stock	4	4	94⅜ — 96⅜	+ ⅜	4 3 0
Globe Telegraph and Trust	£10	6	6†	11⅜ — 11⅝	..	5 1 1
Do. 6 % Pref.	£10	6	6	12⅜ — 13	..	4 12 4
Great Northern Telegraph	£10	20	5†	32 — 34	..	5 17 8
Indo-European Telegraph	£25	13	5†	58 — 60	..	5 8 4
Mackay Companies Common	$100	5	5	85 — 89 xd	..	5 12 4
Do. 4 % Cum. Pref.	$100	4	4	70 — 73 xd	..	5 9 7

Marconi's Wireless Telegraph	£1	20	20	3⅛ — 3⅜	..	5 10 4
Do. 7 % Cum. Partic. Pref.	£1	17	..	2 13/16 — 3 1/16	..	5 10 3
Monte Video Telephone, Ord.	£1	6	6	1 7/16 — 1 9/16	..	6 8 0
Do. 5 % Pref.	£1	5	5	3/32 — 5/32	..	5 14 8
New York Telep., 4½% Gen. Bnds.	100	4½	4½	99½ - 100½	..	4 9 0
Oriental Telep. and Elec.	£1	10	8†	2⅜ — 2⅝	+ ⅛	4 4 3
Do. 6 % Cum. Pref.	£1	6	6	1 7/16 — 1 9/16	+ 1/16	4 11 5
Do. 4 % Red. Deb.	Stock	4	4	87½ — 89½	..	4 9 5
Pacific and European Tel., 4 % Guar. Debs.	Do.	4	4	98 — 100	..	4 0 0
Reuter's	£10	10	10†	8 — 9	— ½	11 2 2
Submarine Cables Trust	Cert.	6	6	126 —129	..	4 13 0
Telephone Co. of Egypt, 4½ % Deb. Red.	Stock	4½	4½	96½ — 98½	..	4 11 5
United River Plate Telephone	£5	8	6†	6⅝ — 6⅞	..	5 16 5
Do. 5 % Cum. Pref.	£5	5	5	5⅛ — 5⅜	..	4 9 0
West Coast of America	£1	2½	..	1 7/16 — 1 9/16	..	4 8 0
Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4	4	96 — 99	..	4 0 10
West India and Panama Teleg.	£0	1½	1½	2⅜ — 2⅝	— 1/16	4 15 3
Do. 6 % Cum. 1st Pref.	£0	6	6	9⅜ — 10⅛	— ⅛	5 18 5
Do. 6 % Cum. 2nd Pref.	£0	6	6	9 — 9⅜	..	6 6 4
Do. 5 % Debs.	100	5	5	97 — 99	..	5 1 0
Western Telegraph, Ltd.	£0	7†	7	13⅜ — 13⅞	..	5 0 11
Do. 4 % Debs.	Stock	4	4	95 — 97	..	4 2 8
Western Union 4½ % Fdg. Bonds	$1000	4½	4½	96 — 98	..	4 11 1

* Unless otherwise stated all shares are fully paid. † Interim dividend. *a* Paid in deferred interest warrants.

Bank rate of Discount 3 per cent., January 29th, 1914.

An Ornamental Power Station.—The outside of the Barmbeck power station (Hamburg rapid transit system) was compulsorily made decorative owing to the proximity of the Hamburg municipal park, and the operating company voluntarily decided to make the inside of the station equally ornate, so that the whole building now forms one of the finest stations (architecturally) in Europe. The outer walls are broken by square-figured panels and arched pilasters round the doorways and windows. The smoke-stack (261 ft. in height) is surrounded by columns for a considerable height, the remainder being fluted. The turbine room and basement are tiled to a height exceeding 6 ft., and the switchboard gallery and stairs are similarly finished. Decorative lines and patterns are used in the window recesses and elsewhere to break the monotony of the tiles, and the lighting and other fixtures are very artistic. The high-tension switchboard compartments are of Duro asbestos, the bottoms being finished with tiles, and a dyke being formed at the front to prevent burning oil overflowing into the aisle. The board itself is of Duro asbestos finished in Dutch tile for the sake of appearance.

TRADE STATISTICS OF INDIA.

The following figures of the imports of electrical and similar goods into British India in the year ended 31st March, 1913, are taken from the recently issued official trade statistics; details for the year ended 31st March, 1912, are added for purposes of comparison and notes of any increases or decreases are given.

	1911-12. £	1912-13. £	Inc. or Dec. £
Brass, wrought.—			
From Great Britain ...	37,000	34,000	— 3,000
,, Germany ...	7,000	10,000	+ 3,000
,, Austria	3,000	3,000	—
,, Other countries	18,000	25,000	+ 7,000
Total	65,000	72,000	+ 7,000
Copper and copper ware.—			
From Great Britain ...	1,023,000	813,000	— 210,000
,, Germany ...	525,000	653,000	+ 128,000
,, Belgium ...	15,000	7,000	— 8,000
,, France	88,000	28,000	— 60,000
,, Austria	7,000	5,000	— 2,000
,, Japan	125,000	61,000	— 64,000
,, Other countries	10,000	14,000	+ 4,000
Total	1,793,000	1,581,000	— 212,000
Iron wire.—			
From Great Britain ...	8,000	55,000	+ 47,000
,, Germany ...	22,000	47,000	+ 25,000
,, Belgium ...	23,000	23,000	—
,, Other countries	16,000	26,000	+ 10,000
Total	69,000	151,000	+ 82,000
Iron and steel plates and sheets.—			
From Great Britain ...	2,809,000	3,194,000	+ 385,000
,, Germany ...	240,000	284,000	+ 44,000
,, Belgium ...	98,000	147,000	+ 49,000
,, United States ...	234,000	200,000	— 34,000
,, Other countries	5,000	1,000	— 4,000
Total	3,386,000	3,826,000	+ 440,000
Steam engines (except locomotives).—			
From Great Britain ...	402,000	312,000	— 90,000
,, Germany ...	22,000	8,000	— 14,000
,, United States ...	9,000	5,000	— 4,000
,, Other countries	5,000	2,000	— 3,000
Total	438,000	327,000	— 111,000
Electrical machinery.—*			
From Great Britain ...	193,000	198,000	+ 5,000
,, Germany ...	30,000	18,000	— 12,000
,, Belgium ...	2,000	1,000	— 1,000
,, Italy	13,000	6,000	— 7,000
,, United States ...	26,000	7,000	— 19,000
,, Other countries	3,000	11,000	+ 8,000
Total	267,000	241,000	— 26,000

* In 1912-13 imports of generators were £38,071, of motors £99,296, of other kinds £103,000. Similar details were not available previously.

Mining machinery.—			
From Great Britain ...	43,000	50,000	+ 7,000
,, Germany ...	—	1,000	+ 1,000
,, United States ...	40,000	11,000	— 29,000
,, Other countries	1,000	1,000	—
Total	84,000	63,000	— 21,000
Machinery, other (except textile and agricultural).—*			
From Great Britain ...	902,000	574,000	—
,, Germany ...	114,000	45,000	—
,, Belgium ...	6,000	5,000	—
,, United States ...	62,000	31,000	—
,, Other countries	19,000	10,000	—
Total	1,103,000	665,000	—

* The details for the two years are not strictly comparable, those for 1911-12 including some items which were not included in 1912-13.

Railway carriages, &c.—			
From Great Britain ...	883,000	1,495,000	+ 612,000
,, Belgium ...	7,000	22,000	+ 15,000
,, Other countries	26,000	67,000	+ 41,000
Total	916,000	1,584,000	+ 668,000
Locomotives and tenders, and parts thereof.—			
From Great Britain ...	526,000	596,000	+ 70,000
,, Germany ...	5,000	7,000	+ 2,000
Total	531,000	603,000	+ 72,000
Rails and fishplates.—			
From Great Britain ...	557,000	769,000	+ 212,000
,, Germany ...	33,000	7,000	— 26,000
,, Belgium ...	2,000	—	— 2,000
Total	592,000	776,000	+ 184,000
Electrical instruments, apparatus, &c.—			
From Great Britain ...	391,000	432,000	+ 41,000
,, Germany ...	35,000	54,000	+ 19,000
,, Belgium ...	1,000	4,000	+ 3,000
,, Austria	4,000	7,000	+ 3,000
,, United States ...	5,000	34,000	+ 29,000
,, Other countries	4,000	21,000*	+ 17,000
Total	440,000	552,000	+ 112,000

* Italy £15,000.

Electric fans.—			
From Great Britain ...	—	20,000	—
,, Italy	Details	14,000	—
,, United States ...	not	19,000	—
,, Germany ...	available.	3,000	—
,, Other countries	—	1,000	—
Total	—	57,000	—
Electric lamps and parts.—			
From Great Britain ...	—	33,000	—
,, Germany ...	Details	8,000	—
,, Austria	not	2,000	—
,, Japan	available.	2,000	—
,, United States ...	—	2,000	—
,, Other countries	—	2,000	—
Total	—	49,000	—
Electric wires and cables.—			
From Great Britain ...	—	132,000	—
,, Germany ...	Details	15,000	—
,, Belgium ...	not	2,000	—
,, Other countries	available.	2,000	—
Total	—	151,000	—
Scientific, &c., instruments.—			
From Great Britain ...	102,000	80,000	— 22,000
,, Germany ...	5,000	4,000	— 1,000
,, United States ...	2,000	2,000	—
,, Other countries	5,000	6,000	+ 1,000
Total	114,000	92,000	— 22,000
Telegraph construction materials.—			
From Great Britain ...	1,000	8,000	+ 7,000
Telephone construction materials.—			
From Great Britain ...	Not	19,000	—
,, Germany ...	available.	1,000	—
Total	—	20,000	—

In addition to the foregoing, the following were imported as Government stores:—

Instruments, apparatus, &c. (except musical).—			
From Great Britain ...	119,000	136,000	+ 17,000
,, Germany ...	3,000	3,000	—
,, United States ...	1,000	—	— 1,000
Total	123,000	139,000	+ 16,000
Machinery.—			
From Great Britain ...	187,000	169,000	— 18,000
,, Germany ...	23,000	1,000	— 22,000
,, United States ...	1,000	3,000	+ 2,000
Total	211,000	173,000	— 38,000
Iron wire.—			
From Great Britain ...	14,000	10,000	— 4,000
Iron and steel plates and sheets.—			
From Great Britain ...	39,000	50,000	+ 11,000
Railway carriages.—			
From Great Britain ...	753,000	734,000	— 19,000
,, Other countries	5,000	—	— 5,000
Total	758,000	734,000	— 24,000
Locomotives.—			
From Great Britain ...	299,000	482,000	+ 183,000
Rails and fishplates.—			
From Great Britain ...	423,000	198,000	— 225,000
Telegraph construction materials.—			
From Great Britain ...	86,000	72,000	— 14,000
Copper and copperware.—			
From Great Britain ...	134,000	97,000	— 37,000
,, Other countries	10,000	58,000	+ 48,000
Total	144,000	155,000	+ 11,000

REVIEWS.

Electric Lighting. By A. H. Avery. London: Cassell and Co., Ltd. 1913. Price 2s. net.

This book is a guide-book for the amateur wireman, and from its very nature can scarcely be expected to receive favourable notice from the practical electrical engineer. It would be difficult to find any branch of handiwork less suited to the efforts of the amateur than "Electric Wiring," and it is certainly a very dangerous proceeding to recommend to the readers of "Work," to whom the preface of the book is specially addressed, that they should undertake the electric lighting of their own houses.

Having said so much, it must be admitted that Mr. Avery has made good use of his opportunities, subject to certain definite self-imposed limitations. The book treats the subject in the most elementary fashion, and deals only with such technical points as would be necessary to make explanation of the instructions easy.

Mr. Avery practically confines his instructions to such as would be required for small houses requiring 20 lights or so, and it is possible that by very carefully following those instructions a satisfactory installation would be obtained. Obviously, however, it is impossible, in a small volume of 150 pages, to foresee all the possibilities that arise in wiring work, and it is just in the small variations from standard arrangements that occur in every installation that the risk of defective work will occur.

For example, Mr. Avery advocates the use of slip tube, and though he rightly points out the importance of the electrical conductivity of the tubing system, there is but little doubt that the great majority of amateurs would fail to ensure this.

Mr. Avery's argument turns mainly on the necessity of satisfying the supply company's inspector, and he seems to imply that if that result is achieved, all is well. As the supply authority has no control over the system of wiring, so long as the insulation is in order, the inducement to do the work properly is small.

Mr. Avery's objection to screwed tubing, by the way, is rather naive. He advocates screwed continuity nipples, rather than screwed tubing, as "any wires already in position do not have to be twisted when tightening up a joint, because neither the tubing nor the fitting turns round, only the screwed nipple."

If anyone should take Mr. Avery's estimate of cost on pages 146 and 147 as representing average figures, it is probable that he will be disappointed, when they are compared with actual results. The quantity of tube provided for 17 lamps, including one 2-light and one 3-light fitting, or, say, 14 points, is 210 ft. only, or an average of only 15 ft. per point—an average run far below what is usually found necessary, even with several points in one room instead of one only, as in the case presented.

Mr. Avery has a chapter on "Self-contained Installations," in which he discusses in 15 pages, including illustrations and diagrams, the possibilities of lighting from an engine plant, from secondary and primary batteries, from water-power, wind-power and from miscellaneous sources. General agreement will be accorded to almost the last sentence in the chapter, which reads—"Manual labour as a motive power is never a very successful idea."

Beyond the Atom. By John Cox, M.A. London: Cambridge University Press. Price 1s. net.

This volume tells, within short compass, the romantic story of the discoveries which, within the last decade, have led us beyond the atom. For its compilation, all the standard text-books have been freely drawn upon, but principally those of Rutherford, Madame Curie, Strutt and Soddy. The author was a colleague of Rutherford, and he says in his preface—"I have also drawn upon my happy memories of those exciting times when, for nine years, I was privileged to witness at close quarters and to discuss from day to day the work achieved by my friend and colleague, Prof. Rutherford, in the Macdonald Physics Building of McGill University, Montreal, of which I was director."

The book is the best we have come across for the man engaged in scientific pursuits, who desires to possess a succinct knowledge of what is now known regarding the atom and radioactivity. It is small, cheap, and to the point; does not involve one in a mass of experimental detail; states the premises easily and gives the conclusions exactly. Nor is it elementary in character, for nothing is omitted that is of any value.

Chapter I commences with a short historical account of discoveries relating to the atom. The position reached in the seventies of last century is summed up in a famous passage from Maxwell's article in the "Encyclopædia Britannica," ninth edition, 1875, which concludes as follows:—"In the present state of science, therefore, we have strong reason for believing that in a molecule, or in one of its component atoms, we have something which has existed either from eternity, or at least from times anterior to the existing order of nature. But besides this atom, there are immense numbers of other atoms of the same kind, and the constants of each of these atoms are incapable of adjustment by any process now in action. Each is physically independent of all the others."

This was written at a time when the march of science had seemingly paused. During the century the whole field of natural knowledge had been systematically ransacked. It was felt that there was very little left for the future. But, as the author says, in science it is very unsafe to venture a negative, and the world was on the verge of discoveries which have given a Sophoclean irony to Maxwell's words.

Chapter II deals with the vacuum tube, and states the results of Crookes's experiments therewith, given in his famous lecture to the British Association in 1878. Crookes concluded that the kathode rays were streams of minute particles travelling at very high speeds, and each conveying a negative charge. Controversy raged round this theory both here and on the Continent, and it was reserved for J. J. Thomson, by a beautiful series of experiments, to clear up the matter and prove that these minute particles were electrons, each a thousand times as small as the mass of the hydrogen atom. The canal rays are next discussed. These consist of streams of particles of atomic size, and there are many types. For instance, in an oxygen tube were found ordinary molecules of oxygen, each consisting of two atoms united; neutral atoms; atoms with single or double positive charges; atoms with one negative charge; molecules with one positive charge; molecules of ozone (O_3) with one positive charge, and O_6 with one positive charge.

The X-rays are then considered. Their main properties are as follows:—They issue equally in all directions; they travel in straight lines, for they cast shadows; their power of penetration is not selective; they can be reflected, refracted and polarised, and made to show interference; they are unaffected by magnetic or electric fields; they excite fluorescence, affect a photographic plate, and render the air conductive. What are these rays? At present they are generally regarded as series of irregular pulses in the ether, but the theory is by no means firmly established.

Chapter III is entitled "The New Rays," and deals with the discovery of and experiments with the radioactive substances. In this connection it may be said that descriptions and diagrams of essential experiments are given throughout the book, but minus all superfluous matter.

Chapter IV deals with the new substances uranium X, thorium X, &c., the emanations from the radioactive substances, and the active deposits found on solids which have been in contact with the emanations.

Chapter V has to do with disintegration, and Chapter VI gives a family tree of radium and its derivatives. In connection with the disintegration theory, the confirmation by Dr. Gray and Sir William Ramsay is mentioned. These experimenters have succeeded in directly determining the molecular weight of the radium emanation, by weighing it and measuring its volume, temperature and pressure. The results of five experiments range between 227 and 218, with a mean of 223. Since the equivalent of radium is now established at 226·4, that of the emanation, resulting from the loss of one α particle, should theoretically be $226{\cdot}4 - 4 = 222{\cdot}4$, an extraordinarily close agreement.

Chapter VII is on "Verification and Results." For this

purpose a few of the leading verifications are collected together.

Chapter VIII deals with the objective reality of molecules. A student may well be staggered by the inconceivable minuteness of the quantities in which he is called upon to believe. He may well ask himself whether the whole thing is not a myth or a delusion. But it is clearly shown here that the molecule is an absolute fact of Nature.

The last chapter considers the "New Atom" in the light of the foregoing. The general conclusion is as stated in the author's last paragraph:—"The new knowledge gained in the last decade is a true development, not a destructive resolution. Conservation of energy stands where it did, though unsuspected and enormous stores of atomic energy have been brought into view. And the atomic theory is still the guide of the chemist, though for the purpose of modern physics he has been compelled to look beyond the atom, and in the words of Blake:—

> To see a world in a grain of sand,
> And a heaven in a flower,
> To grasp infinity in the palm of the hand,
> And eternity in an hour.

—W. J. CRAWFORD.

Electric Circuit Theory and Calculations. By W. P. MAYCOCK. London: Whittaker & Co. Price 3s. 6d. net.

This work is intended to supplement the author's "Electric Wiring, Fittings, &c.," and his "Electric Lighting and Power Distribution." The ground covered by the present volume is primarily that embraced by the Grade I and Final City and Guilds Examinations in wiremen's work. The theoretical principles underlying numerical problems in electric installation work are expounded, and the working of such problems is illustrated. Magnetic circuit problems relate rather to design than to installation work, and accordingly receive no treatment in this volume. The numerous worked examples presented are divided into groups, each of which is preceded by a more or less complete exposition of the theoretical principles involved. Since the work is intended for the use of elementary students, no theoretical considerations of A.C. problems are included. It is an extremely difficult matter—particularly when one is familiar with theory—to determine exactly how much theory can safely and profitably be left out of such a work as this. On the whole, we believe the author has throughout drawn the line very suitably between explanation and mere statement.

The electric circuit and Ohm's law first receive treatment, and the information presented concerning battery E.M.F. and resistance, and the best combinations for various services, should do much to improve the practice of electric bell installation. In connection with Ohm's law and A.C. circuits (page 20), we think the author would be wise to take the reader more into his confidence concerning the "mechanism" of inductance in a choking coil. Following notes on the electrical production of heat and light, and instructive experiments with volt and ampere-meters, the author discusses the characteristics of conductors and non-conductors, and goes on to deal with the uses and qualities of various insulators, and with dielectric strength. The ensuing 40 pages take up the various principles and methods involved in calculations of resistance, conductance, conductor area, series and parallel circuits, &c. Here, as elsewhere, the paragraph headings are set out boldly so as to facilitate the finding of the exact section required, and the numerous examples are arranged very clearly.

The author explains clearly why the maximum permissible current density depends on the size of insulated conductors, and then proceeds to a consideration of pressure drop in closed and pressure distribution in open circuits. We do not care for "a.p.s.i." as an abbreviation for amperes per square inch, and, while on the subject of abbreviations, we see no advantage in terming the KW.-hour a *kelvin*. The name of Kelvin needs nothing to immortalise it; KW.-hours is as quickly written; and the term kilowatt-hour is descriptive, whereas *kelvin* is merely abitrary. The case of a fundamental unit (such as the ohm, the volt or the inch) is, of course, quite different.

The meaning of direct-current power and calculations connected therewith are explained clearly; the interpretation and calculation of lamp and machine efficiencies are dealt with, and three-wire systems and their economy are considered. In a later edition, we think it would be wise to explain phase displacement in A.C. circuits, power factor and A.C. circuits and power calculations in greater detail. In the present edition, the author endeavours to spare readers the admitted difficulties connected with A.C. circuits but, in these days, we fear these difficulties must be encountered and overcome by every electrical engineer, and the present work is certainly one in which a thorough and exact grounding in A.C. calculations might very well be given. A.C. power and the numerical evaluation of measurements and problems connected therewith form at present a dreadful stumbling block to most students.

The author discriminates clearly between amount of heat and temperature, and between power and work or energy, and then deals at some length with practical electric heating and illuminating calculations. Leakance and insulation resistance are dealt with clearly as regards general principles; the I.E.E. and Phœnix rules are presented; and insulation resistance in ordinary circuits and in those exalted installations employing "modern switching systems" is considered. The comparison between gas and electric lighting and costs follows well-known lines, and the notes on charging systems should prove very useful.

At first we were surprised to find 40 pages devoted to arithmetic (decimals, proportion, reciprocals, equations and square roots), but on consideration, we believe this feature to be thoroughly good. Many men in practice become rusty in their arithmetic and a separate treatise, devoted exclusively and minutely to this subject, does not meet their needs, which are, however, well covered by the appendix to this volume. This work is to be recommended as excellent value. It is well arranged, well produced, well indexed, and contains 356 problems with answers, in addition to the large number of fully worked examples in the text.

NOTES FROM CANADA.

[FROM OUR SPECIAL CORRESPONDENT.]

AN interesting light on the accuracy of modern electricity meters when turned out from the factory is thrown by statistics published by the Dominion Government in a recent report showing that, during 1913, 118,639 meters were tested, out of which number only 189 were rejected. It should, perhaps, be explained here that each individual electricity meter, before it can be put into service, must be tested by the Government inspectors and stamped by them.

It is proposed to utilise lignite coal (of which there are extensive deposits in the Province) in the Edmonton district of Alberta for the generation of power on a large scale and to transmit the power at high voltage to the surrounding places.

The city of Edmonton contemplates spending about £100,000 this year on extensions to the electric power plant.

In Fort William, Ontario, a by-law is being submitted to raise money for improving and extending the telephone system, and the spending of about £18,000 is contemplated. Money has been already voted for the extension of the electric street railway system.

By-laws have also been carried recently in Hamilton, Ontario, and Humboldt, Saskatchewan, to spend $335,000 and $20,500 respectively on extensions to the electrical system.

Municipal ownership is becoming very popular in Canada, and frequently one hears of a street railway or electric lighting system being bought up by the town. Nelson, B.C., has just recently decided to buy the local street railway system.

Anyone who has been in Toronto during the last three years or so is almost sure to have heard of the battle that has been raging, largely in the newspapers, over the question of the city buying out the Toronto Street Railway Co. and the Toronto Electric Light Co. Several times it has seemed that the matter must shortly be decided one way or another, but, for some reason, nothing is done, and the long-suffering citizens pack themselves into the cars so closely, and the air therein rapidly becomes so foul, that one has visions of a mild form of Black Hole of Calcutta. For years this state of affairs has been declared to be absolutely intolerable, but it goes on still. Municipal tramcars, tubes and motor-'buses have been, and are now, acclaimed as suitable means of freeing the city, but nothing tangible has yet been accomplished.

It was announced a little while ago that a charter for a railway 111 miles long, to be operated electrically, and to run across the State of Maine and connect with existing lines in Quebec and New Brunswick, had been secured by the president of the St. John Valley Railway Co.

A goodly number of British firms are now represented in this country, and some few are erecting works here, among these being Armstrong, Whitworth & Co., who are building a large plant at Longveuil, Quebec. The Montreal Light, Heat & Power Co. will supply current for lighting and power.

Reference was made recently in these notes to the fact that two firms had come forward with proposals to build tubes for the city of Montreal. It is now understood that engineers there are preparing a report recommending that subways be constructed at once, connection being made with existing surface car routes.

Diesel engines and oil-fired boilers are recommended as reserve plant for hydro-electric power at Point Grey, B.C. The former seem to be growing in favour in Western Canada, as there are several plants in operation, and in some instances repeat orders have been given for additional plant.

The State of New York has sanctioned the formation of a new company which will import 46,000 electrical horse-power from the Electrical Development Co., on the Canadian side of Niagara Falls. The former company is limited to an average charge of $19 per horse-power year—*i.e.*, it must not pay more than this for its supply of energy.

This is a very different figure from the $9 per horse-power which the Hydro-Electric Power Commission of Ontario pays for its power, and no doubt the Electrical Development Co. will make a good profit out of the $19 charge.

According to the daily papers, the idea of utilising the very considerable fall which exists in the Niagara River between the foot of the falls and Queenston, where the river joins Lake Ontario, is being again brought up. The difference in level between these two points is about 60 ft., and it is stated that about 400,000 H.P. could be developed.

It is quite likely that this year will see the appointment of a commission to inquire into the power possibilities of the St. Lawrence River, which are very great; and it is probable that very soon an inquiry will be made by a commission on behalf of the Dominion Government into the commercial feasibility of the Georgian Bay Canal. The engineering problems have already been considered and reported on, but many people appear to think that it would be a financial failure. As it would be possible to generate a considerable amount of power by utilising the falls at the various locks, this point will receive the attention of the proposed commission, if one be formed.

Albania.—A German-Austrian company has been formed, under the style of the Deutsch-Oesterreichische Handels und Industrie Gesellschaft, with offices in Berlin, Trieste and Durazzo, for the financing and promotion of industrial undertakings in Albania. Large industrial firms, several banks, and a number of Albanian notabilities are joined in the scheme. The building of roads and the erection of factories are among the first objects of the promoters, for which electricity generated by water power will be employed. As Albania is plentifully provided with water, it is believed that the factories will soon be supplied with an abundance of cheap motive power.—*Zeitschrift für das Gesamte Turbinenwesen.*

RELIABILITY OF SUPPLY AND THE MAINTENANCE OF PLANT.

By L. MARSHALL JOCKEL, G.I.Mech.E., A.Am.I.E.E.

The increased outputs of so many of our generating stations of late are no doubt largely due to the fact that the public are coming to regard a supply of electricity as not only a cheap and most serviceable commodity, but one which can be relied upon as well. The managements and directorates of manufacturing and industrial concerns have, with true commercial instinct, generally kept pace with the times, and availed themselves of a cheap and reliable supply of electricity when such has been offered, with due regard, of course, to the condition of their own power plant, and the capital expenditure incidental to changing over.

These factors have no doubt been instrumental in increasing station outputs generally, and those of municipal stations particularly, with, of course, the happy result that load factors have improved, and up-to-date and highly efficient generating plant has been installed to meet the new conditions.

Reliability of supply or service is therefore of paramount importance, and the modern generating station can only be a financial success when the conditions necessary for this essential obtain. In the case of power companies, the consumers may possibly be protected by indemnity agreements against financial losses due to an interruption in the supply, but up to the present municipal undertakings appear to fight shy of power supply under such conditions, although in the majority of cases they are probably in a better position with regard to standby plant and the loading of the distribution system.

The actual results of a shut-down can, however, hardly be gauged from a financial point of view, as the shattering of public confidence which is entailed has far-reaching effects, particularly in regard to prospective consumers, the lay mind naturally taking a considerable time to forget such incidents.

In view therefore of the great importance of reliability and continuity of supply, it is imperative that the generating machinery and the distribution system receive every possible attention and be maintained in first-class order and a high state of efficiency.

Whilst a defect in the distribution system is certainly unfortunate and detrimental in many respects, yet it must be allowed that a defect in the generating station equipment is usually of far greater importance, imperilling as it may the continuity of supply of the whole area served by the station. This is particularly the case in modern stations where a large area is often supplied from a central source in order to obtain the inherent advantages attached to generation on the most suitable site by means of large and therefore efficient units of plant.

Although the employment of large generating units certainly savours somewhat of the adage of "putting all one's eggs in one basket," yet the actual results would seem fully to justify this practice, and the tendency in up-to-date stations run on commercial lines, is to reduce the capacity of standby plant to as small an amount as possible consistent with safety, for obvious reasons. Further, the improvement of the load factor, which in most instances is due to the acquisition of a power load, generally results in the more precise loading, and possibly temporary overloading, of suitably graded plant, and this, of course, entails the necessity of maintaining the generating machinery in first-class condition, whilst low works costs can only be obtained by keeping the plant in a high state of efficiency.

Obviously then it is necessary that all routine work, such as cleaning, inspection, and minor adjustments to plant be efficiently carried out, and all

defects which may develop in working be promptly discovered and rectified, if possible, before a breakdown somewhat forcibly concentrates attention on the matter and imperils the continuity of the supply. In a modern station of any importance it is generally conceded that the establishment of a system is necessary to ensure that such work is properly carried out, although there is perhaps a certain amount of so-called "red tape" almost inseparable from any system. Despite the disadvantages of "red tape" (which are perhaps sometimes unduly enlarged upon) there is much to be said in favour of a definite system, whilst it has the advantage of defining the responsibility of both the men and the officials responsible for supervision.

The actual system adopted in any specific case will, of course, be largely dependent upon the particular conditions obtaining, such as the size of the station, the class of plant installed, and the provision or otherwise of an adequate staff, while the individualities of the resident engineer and the executive officials will generally be influential factors. The personal factor is naturally of importance in any station, not only on the part of the resident engineer, but of his assistants as well, for unless there is a healthy spirit of camaraderie existing among the supervising staff, the best of systems will in all probability possess an inherent weakness.

Intimately bound up with the personal factor is the question of the training and capabilities of the supervising staff, for the writer is convinced that in a station of any importance the best results can only be obtained when the plant is in charge of properly qualified engineers, who have had both workshop and subsequent central station experience. Unfortunately the salaries offered in many undertakings do not attract the proper class of men, and the results are sometimes obvious on the cost sheets, for despite the introduction of up-to-date and highly efficient plant, the most sanguine expectations of the chief are never quite realised, or, if realised, are possibly not maintained for any great length of time. This is particularly true in regard to the steam-raising plant, for in a modern station some 50 to 70 per cent. of the works cost is generally accounted for in the boiler house, and obviously here is scope for economy and efficiency on the part of a properly trained engineer with sound mechanical experience.

Turning now to the actual question of routine and maintenance work, it will be evident that no very hard and fast rules can be laid down without a detailed knowledge of the specific conditions obtaining in any case, but experience in different types of power stations under public and private administration is certainly very helpful when considering the adoption of a system. Taking what is perhaps the most general case, a station of moderate plant capacity giving D.C. supplies for traction, lighting and power, and also a three-phase H.T.A.C. supply, the running staff will be under the direct supervision of the charge engineers, who in turn are responsible to the station engineer or superintendent, while the maintenance, or repair staff, will be responsible to the station superintendent.

The usual routine work such as cleaning, periodical inspection and testing of engine room plant, and possibly light repairs, will be undertaken by the running staff principally on the day and night shifts and at week-ends, while the maintenance of the boilers and engines and other heavy plant will be carried out by the repair staff, who are usually fitters with little or no technical knowledge. This system is fairly satisfactory in practice and possesses certain good features, but unfortunately it takes little account of the abilities and personality of each of the men concerned, and usually throws a somewhat excessive amount of responsibility on the station superintendent. Numerous instances of trouble which need never have arisen could be cited to illustrate this weak link of the system, the root of the whole matter generally being traceable to an insidious slackness or want of conscientiousness on somebody's part, the somebody concerned usually succeeding in escaping the consequences. Where this system is considered thoroughly satisfactory, it will generally be found on careful investigation that its successful working is not so much due to the system itself as to the fact that certain individuals (probably only one or two) either possess a splendid spirit of conscientiousness or else take an unusual interest in their work, it being almost a physical impossibility for the station superintendent to keep in touch with every detail relating to both the plant and the men engaged on the running and maintenance staffs.

In some stations a system of routine and maintenance work is adopted in which the plant is divided up into sections, and each section allotted to a responsible member of the running staff. The actual allocation of the plant will, of course, vary in different types of stations, but speaking generally, the charge engineers and switchboard attendants will each have a certain portion of the engine room plant, for the efficiency and cleanliness of which they will be held personally responsible. The sections of plant may be arranged so that each charge engineer has, say, one or more of the generating sets, with its auxiliaries and pipework, and possibly a section of the converting or transforming plant, while each switchboard attendant may have a portion of the switchgear, battery and booster plant, and electrical auxiliaries and lighting circuits, etc.

If there is a grading of the technical staff as regards pay, and seniority, or to lessen the effect of any question of overlap with regard to the sections, the allocation of the plant may be arranged so that each charge engineer or switchboard attendant has a complete portion for which he is responsible. For example, the senior charge engineer may have the prime movers and generators, the second charge engineer the condensers, auxiliaries and pipework, while the third charge engineer could be responsible for the converting and transforming plant or auxiliary machinery in the engine room and boiler house.

The boiler plant should preferably be under the direct supervision of the station superintendent, for unless it is kept in a high state of efficiency and repairs are promptly executed, the works costs will unmistakably bear witness to the fact.

The actual cleaning of the plant will, of course, be allocated to the cleaners or greasers whether the responsibility is divided up or not, but it is futile to expect that a cleaner, who has a portion of the plant under his care, can also take the responsibility for routine and maintenance work, which generally requires some engineering training and technical knowledge for its efficient carrying out.

The adoption of a system on the lines indicated renders it necessary for each item of the plant to be thoroughly inspected from time to time by the person responsible, any extensive repairs required being promptly reported to the station superintendent, so that if necessary the plant affected may be taken out of commission and thus not jeopardise the reliability of the supply. If thought desirable a report sheet can be made out, say, every week by the charge engineers responsible for each portion of the plant, the sheet giving particulars regarding the routine work and also details of any adjustments or repairs executed, which can be entered up later in the plant record books or filing system.

It may be argued that the adoption of such a system entails extra work on the part of the charge engineers and the switchboard attendants, who in some stations are sufficiently occupied with running duties, but generally the time involved is a comparatively small fraction of the shift, and in practice the argument proves to be more apparent than real.

It is undoubtedly true that unless the responsibility of each member of the staff is clearly defined and a definite system of working inaugurated, then it is indeed a difficult matter to unearth the responsible person if a breakdown of plant or interruption of the supply occurs, either due to neglect or the adoption of a don't worry policy, for "what is everyone's job is no one's job," and satisfaction is neither given nor obtained.

THE GULSTAD VIBRATING RELAY.[1]

By W. JUDD, M.I.E.E.

In this description of the Gulstad Vibrating Relay the object is to bring to general notice this remarkably ingenious and efficient piece of telegraph apparatus.

Devised by Mr. K. Gulstad, some time Engineer-in-Chief to the Great Northern Telegraph Company of Copenhagen, and given freely to the world by means of descriptions in the Electrical Review of June, 1898,* and August, 1902,† it has been in use by that company for over 20 years, and in more recent years by other telegraph administrations to a small extent.

This relay, while being several times as sensitive as the ordinary polarized relay, is at the same time much more stable in the presence of disturbances from neighbouring lines, or from a defective duplex balance. These most important and valuable features consequently give a higher speed and more stable signals than any other polarized relay known to the writer.

It is only applicable to double-current Morse signalling, and is efficient on all land lines and submarine cable having a K R of from 0.5 to 0.75 second. On a cable having a K R of 1 second it will give very fair results, but that is rather beyond the safe limit.

The somewhat remarkable combination of increased sensibility to signals and increased stability against disturbances, appears to be explained by a consideration of the vibratory circuits. Premising that no line current is present, it will be seen that when the tongue of the relay comes in contact with one or other stop, a condenser is charged through one relay auxiliary winding, pressing the tongue momentarily on this stop. Then, the condenser being charged, the current rises in the opposite auxiliary winding, through an external resistance, and pulls the tongue off, when the discharge current from the condenser flowing through both auxiliary windings throws it vigorously over on to the other stop. The same cycle of operations is then repeated with opposite polarity of the battery. In this manner a continuous and regular vibration of the armature and tongue is set up, with contacts firmly made and cleanly broken.

The speed of these vibrations must be made equal (or nearly equal) to the pre-arranged speed of dot signals from the line to which the relay is applied, by suitable adjustment of the values of capacity and resistance in the local circuit, and the rate of rise of the local current also must be made to correspond with that of the cable current.

When these conditions are fulfilled, the only duty left for the cable current is to control the vibrations. This control is obtained by furnishing the electromagnets of the relay with a separate winding through which the signals received from the cable pass.

The heavier currents in this "main" winding, *i.e.*, the cable "dash" or "space" signals, overpower the local vibrations, and hold the tongue on one or other stop according to their polarity, until such time that the dash or space being completed at the distant end of the line the strength of the cable current at the receiving end falls below that of the local current by an amount giving a preponderance to the latter. The armature is then surrendered to the local forces, is pulled off, and is driven vigorously over to the opposite contact by the discharge from the condenser.

When "dots" are received from the cable their current amplitude is so small that only a very slight control, and in some cases practically none at all, is exerted over the tongue.

If the cable to which the relay is applied is a short one, the dots may control the tongue's vibration to the extent of accelerating or retarding its natural rate, thereby tending to correct any difference of phase between the impulses of the cable dots and the relay vibrations. In working through a moderately long cable, however, the current amplitude of dots at the receiving end would not have any appreciable influence upon the vibrations, and only the heavier dash and space currents would control the relay, which, however, would still reproduce the dots perfectly, by reason of the continuation of the local vibrations during periods when no controlling force is present in the main winding to check them.

Briefly stated, the resultant effect of the controlling cable currents and the local currents in the relay is this: that where dots received from the cable are to be reproduced, the vibrations are allowed to continue, and where dashes or spaces occur, the vibrations are damped out; and the short and long

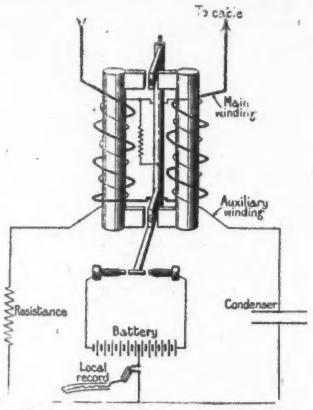
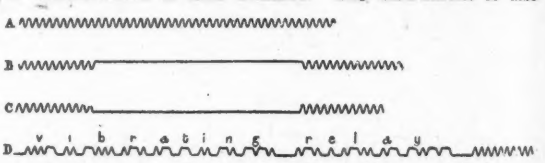


Fig. 1.—The Gulstad Relay.

contacts of the tongue thus obtained are registered on the local recording instrument with all the increased firmness and definition supplied by the local forces.

With the Gulstad relay the cable current is relieved of the work of moving the armature and of overcoming the magnetic inertia which falls upon it with an ordinary polarized relay; great sensitiveness is thus attained. The instrument is also



A, Vibrations free; B, Vibrations checked by marking current (dashes, &c.); C, Vibrations checked by space current; D, Signals.

Fig. 2.—Signals Registered on Local Record.

very adaptable to signals of varying character or of distorted formation, by reason of the elasticity of the electric combinations in the local circuit.

The accompanying diagrams, Figs. 1 and 2, illustrate the relation of the relay to its auxiliaries and show an example of the signals produced by it on the recording instrument.

[1] Excerpt from the *Journal of the Institution of Electrical Engineers.*

* Electrical Review, Vol. 42, pp. 751 and 792, 1898.

† *Ibid.*, Vol. 51, pp. 294 and 332, 1902.

THE ELECTRICAL TRADES BENEVOLENT INSTITUTION.

The annual general meeting of the above society was held on March 19th, at the Institution of Electrical Engineers, Victoria Embankment, Mr. A. Bruce Anderson presiding.

Before the business was proceeded with, the Chairman remarked that since the last meeting they had lost Sir William Preece, their President. He was a man ripe in years, full of the honours which the profession could award him, and much esteemed by all who knew him, and his death was greatly regretted.

In moving the adoption of the report and accounts, the Chairman said it was satisfactory to see that the grants were more than double those of the previous year. That, of course, was what the Institution existed for, and it was evidence of satisfactory progress. If they could continue doubling their grants for a few more years they would soon reach respectable figures. He must say that he felt that the work of the Institution was not sufficiently appreciated. There was no doubt as to its need, and he did feel that something ought to be done to make it a bigger thing than it was to-day. Many of the leading members in the industry had given a great deal of time to looking after the affairs of the Institution, and many had subscribed handsomely to the funds, but the smaller manufacturers and the rank and file of the industry had not yet been educated up to the necessity of supporting the Institution.

Mr. Justus Eck, Chairman of the Committee, in seconding the motion, said that it was very satisfactory to find that last year there had been an increase in the support accorded to the Institution, and that there had also been an increase in the money distributed in relief. As the Chairman had told them, they had spent double the amount in relief in 1913 as compared with 1912, and 1912 was double that of 1911, so it would be seen that they were making progress, and from what he had seen he thought he could tell them that the current year would be well ahead of its predecessors. They had had to cut

their coat according to their cloth, and while they would have liked to have gone in for more propaganda work, their funds had not permitted of their doing so to any great extent. He found that when he made it a personal matter he could induce persons to join or subscribe to the funds, but it was very difficult to bring the claims of the Institution before those whom they particularly wished to see as members. He would particularly like to see the smaller firms, the electrical contractors, and the small manufacturers or middle-men come in, for such firms could not look after their men in the same way as the big electrical companies and firms did. In the year 1913 the total capital invested in the railways of the United Kingdom was 1,340 million pounds, and the Railway Benevolent Institution, which looked after the railway servants, had an income of £76,000. He believed there were some 500 million pounds invested in the electrical industry, and therefore, in comparison with the railway industry, the income of their Institution was nowhere near in proportion to that of the Railway Benevolent Institution. He was hopeful that this year they would extend their activity to the provinces.

The report was adopted.

The following retiring members of the Committee were re-elected :—Messrs. W. B. Esson, E. Garcke, T. E. Gatehouse, C. E. Hunter, C. Koettgen, W. Schmahl, A. A. Campbell Swinton, L. Thurnauer, and R. J. Wallis-Jones; and Lieut.-Col. Leaf and Mr. W. C. Mountain, of Newcastle, were added to the Committee.

The resignations of Mr. W. Davenport and Mr. T. J. Grainger as members of the committee were accepted with regret, and votes of thanks were accorded them for their past services.

A short discussion ensued as to the desirability of more of the rank and file of the industry becoming members of the Institution, Mr. W. R. Rawlings, Mr. R. W. Hughman, Mr. H. Bevis and other speakers pointing out that there was an impression abroad that the Institution was mainly an employers' affair. The speakers emphasised the fact that the Institution was really in the nature of a provident society, and that it should look for its main support from the rank and file who, in the event of need, could claim its benefits.

Mr. F. B. O. Hawes (the Secretary), while agreeing with the previous speakers, gave it as his opinion that they could not expect the rank and file to come in all at once. The class of "members" had, he said, only been in existence for about two and a-half years, and the numbers had steadily grown, and this year it would be found that the membership had increased 50 per cent.

A cordial vote of thanks to the Chairman, proposed by Mr. Guy Burney, and seconded by Mr. T. E. Gatehouse, concluded the proceedings.

ELECTRIC BATTERY VEHICLES.

Opening a discussion on this subject at the Institution of Electrical Engineers, on March 19th, Mr. F. Ayton said that the importance to the central station of the load to be obtained by a general use of electric vehicles could hardly be over-rated. It was in practically all cases an "off-peak" load; and as it would in nearly all cases come on during the night, when the majority of the other consumers had ceased to make any demand on the supply, it would have a tendency to flatten out the generating-station load curve in a most favourable manner.

At the moment, the most promising opening for the electric vehicle appeared to lie in its use for commercial purposes; but it was by no means improbable that the passenger-carrying vehicle would eventually be considered from the central station point of view almost as important as the commercial type.

It could not be too strongly emphasised that the electric vehicle of to-day was not to be judged by the experiences of even a few years ago in this country. Great advances had been made in storage battery construction, the design of the motors for electric vehicles had been improved, ball and roller bearings had been brought to a high pitch of perfection, chassis construction had been lightened, and better and more efficient rubber tires could be obtained.

The proper sphere of utility for the electric vehicle at the present time was undoubtedly in interurban and suburban districts where its mileage limit per charge was not a drawback. The lighter vehicles were generally capable of doing from 50 to 60 miles per charge, and in most cases this covered the daily requirements for work in such districts.

In the United States alone there were over 37,000 electric vehicles in use, of which more than half were passenger-carrying machines. About 40 firms were engaged in constructing these vehicles in America. In certain cities on the European Continent, also, this type of automobile was rapidly coming into general use, and hundreds were already running and giving satisfactory and economical service.

Within its own sphere the electric vehicle could show a degree of economy, and a record for reliability, with which no other existing type of vehicle could hope to compete.

For haulage purposes in large towns the days of the horse were numbered, and upon the basis of operating costs the electric vehicle was the only type of power-driven machine that could take its place. The relief of the traffic congestion in the main streets of our large cities and towns was an acute and pressing question. A general widening of main thoroughfares was economically out of the question; more efficient use must be made of the present street area. One obvious method of obtaining relief was to bar horse haulage entirely. A pair of horses and a large van took up nearly double the street area required for an average motor-vehicle of the same capacity, and for equal carrying capacity the electric vehicle took up the least space of any. Considerable further relief of the congestion would follow from the fact that a good commercial motor-vehicle could do in the same time more than twice the amount of work of two double-horse teams in city service. An immense saving would accrue to the business community by the wholesale adoption of motor transport for city service.

The already extensive adoption of the petrol type of commercial vehicle for this purpose had brought in its train noise and smell, which were frequently the cause of bitter complaint. Both these disagreeable features were absent from the electric vehicle, and for this reason alone it should assuredly commend itself for universal adoption in large cities and towns.

The position of the electric vehicle could hardly be considered apart from methods of charging its battery. With the batteries at present fitted, the impressed voltage required towards the end of the charge was in the neighbourhood of 110 to 120 volts. Since the supply pressures in use were generally above 200 volts, in most cases the charging must be done through the medium of some pressure-reducing apparatus. It was essential that the charging operation should be made as simple as possible—practically automatic. It therefore remained for the central station authorities and the manufacturers to see that reliable automatic apparatus was provided, so constructed that when the correct terminal voltage for the whole battery (which was a good approximate indication of the battery's condition) had been reached, the motor-generator was automatically shut down. It was of great importance that vehicles should be able to run into any place where charging facilities were provided, and get connected up with ease. This pointed to the necessity of standard charging receptacles and plugs. The Electric Vehicle Committee, realising the importance of this, had decided after careful consideration to recommend to the British Engineering Standards Committee the desirability of adopting the 150-ampere plug and receptable of the Electric Vehicle Association of America as the standard fitting for this country. They could not look for much assistance at the present time from existing motor traders and garage proprietors. The pioneer work had to be done, and it behoved the electricity supply authorities, as those who were going to benefit most by the extension of the use of the electric vehicle, to work hand in hand with the manufacturers and to carry on an active propaganda for advertising the electric vehicle. They must show the public that it was by far the simplest and most sturdily constructed power-propelled vehicle at present on the road, and advertise all its other good qualities, its ease of driving, its all-round economy, and its reliability.

At the conclusion of his introductory remarks, Mr. Ayton stated that he had received a letter from Mr. P. P. Wheelwright (Blackburn), who pointed out the difficulty of getting any guarantee of mileage from petrol vehicle makers. The first cost of the electric car was high, but subsequent running costs were much lower than for a petrol car; the roadster vehicle which he used for inspection purposes ran three miles on one unit.

Mr. J. W. Beauchamp (West Ham) mentioned that he had six of the heavy type electric vehicles in use in his district, and the average revenue to the station was about £20 each per annum. The car-mileage obtained in practice was uncertain, depending on the conditions of use. There were several good electric vehicles available, but their introduction and the future of the business was really a financial question. If money could be introduced to finance contract haulage schemes using electric vehicles, he felt sure that they would be successful, being cheaper than other forms of power wagon, and many electric trucks would, no doubt, be sold when they were seen in use. He pointed out that 1,200 heavy electric trucks in West Ham would take as much energy as the Corporation tramways; also, that the cost of energy was only about 20 per cent. of the operating cost, and that it would be unwise to cut down the selling price until more experience had been obtained.

Mr. R. J. Mitchell (Edison Co) said he thought ¾d. per unit would be a suitable all-round price for charging energy, and 1½d. would be too high. The electric vehicle was most likely to cut out the numerous horse vehicles which congested the street and stopped all other traffic. A petrol truck rated at 35 ton-miles per gallon only did about 15, owing to the condition of the streets. He suggested that the University of London might institute a research, similar to that carried out in America, with a view to obtaining reliable information and data as to transport methods and costs; it would add to the confidence of the user if a scientific body's opinions were available on the matter. He did not think that the central station engineers should be expected to spend much money on providing charging facilities at the commencement, and hoped that the Vehicle Committee would reconsider its verdict as to the non-earthing of plugs, as it might be possible under certain conditions to get 230 volts between the frame and earth.

Lieut. Sladen (London Fire Brigade) gave some particulars of the vehicles in use by the London Fire Brigade (which have been described by us). He said they were using lead batteries, and the vehicles weighed about 5¼ tons, or from 5 to 6 cwt. more than similar petrol-driven vehicles. The results obtained were so satisfactory that the "electric" had been adopted almost as a standard for life-saving appliances where the gradients were moderate. The cost of such vehicles averaged about 1s. per mile, not including

depreciation and capital charges, but petrol-driven vehicles cost about 1s. 3d. per mile. If all charges were considered, both types of vehicle were about equal—£150 per annum. Maintenance and renewals on escape vans worked out at about £40 per annum. They required a maximum pressure for charging purposes of 240 volts, but very few London undertakings would supply at less than 400 volts, and charging apparatus was installed in each station. The charging bill at most stations only came to some £2 per quarter. He emphasised one valuable feature of the electric type of vehicle, viz., rapidity of turn-out; this took 7 or 8 secs. only, and was absolutely unequalled by any other type of car, for which the best time was 15 secs. The electric vehicle started off at top speed, being instantly ready, while the others required time to get fully going, and this was a matter of importance, as the runs only averaged about ½ mile. Electric braking was also a valuable feature in the operation.

Mr. P. A. Mossay pointed out that the electric vehicle had a higher efficiency than any other. He urged the importance of studying the operation of such vehicles in detail, mentioning that as the result of comparative tests with different sizes of tires, it had been

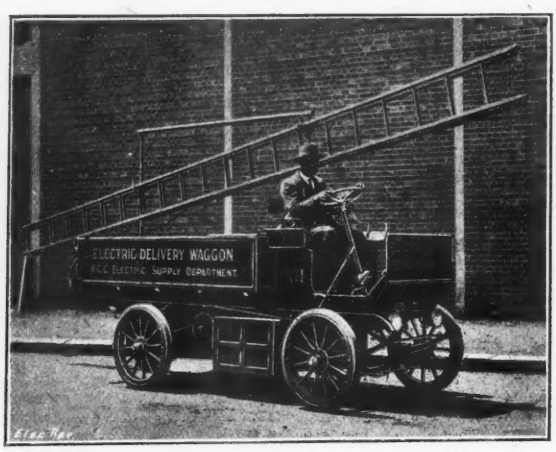


Fig. 1.—Baker Half-Ton Electric Truck used by the Melbourne Electricity Department.

found that a greater car-mileage was obtained, with the same battery and vehicle, when larger tires were used. Five years' experience in Germany showed that the tires of electric cabs had an 80 per cent. longer life than those of petrol cabs. He concluded by showing numerous slides illustrating the progress made by German makers in municipal and commercial battery vehicles.

Dr. C. Porter (Marylebone) laid stress on the hygienic advantages of the electric vehicle, which was the only one which was really silent and did not contaminate the air, giving discomfort which was inimical to health.

Mr. C. Barber said it was not sufficiently realised that the present-day vehicle battery was very different from the older ones; he thought it would be found that for 30 to 40 miles per day the electric chassis of 10 years; he was satisfied that it cost 25 per cent. less to operate the battery vehicle. The battery maker must satisfy the user in regard to battery upkeep. His own experience on battery maintenance was that materials cost from 1d. per mile for light vehicles up to 2½d. per mile for a 5-ton vehicle. If, further, the removal of the battery to and from the garage were included (complete maintenance) these costs would be increased to from 1½d. to 3½d. respectively. The figures given were derived from a number of vehicles. There were 15 battery 'buses at Brighton, which compared with the 5-ton vehicle, and had been in use for six years, and battery maintenance (with the exception of removal of batteries) remained below 3d. a mile. The efficiency of the lead battery in practice was about 75 per cent. The cost per mile held good for a car running a good mileage. The batteries mentioned at Brighton saw two years' service before going there with a London electric 'bus company.

Mr. E. Fox pointed out that the operating mileage of vehicles depended on conditions of use, and often 50 miles a day was not required; one London house found its daily average mileage was only 32. There would, however, be no difficulty in designing a chassis for 100 miles operating radius. It was easy to detect faults in the "electric" when in use, but a petrol car required an expert mechanic to inspect it. The electric vehicle also facilitated accurate cost keeping.

Mr. H. Brazil gave some particulars of the running of a lorry weighing 9½ tons loaded, which consumed 1·3 units per mile and had a range of 35 45 miles. The control system fitted tended to reduce heavy discharges and maintain the battery in good condition.

Mr. A. J. Makower gave some figures relating to the use of electric battery cabs in a German city. A hundred cabs were in use, each averaging 90 miles a day and 350 days a year service. The cabs each weighed 2·4 tons. The operating costs were battery ·99d.; current, ·90d.; tires, 1·87d.; driver (day and night service), 1·56d.; repairs, ·71d.; general expenses, ·63d.; depreciation, ·33d.; making a total of 6·99d. per mile run. About 31,000 miles were run per annum, and 2½ million units would be required, costing, say, £11,000. The figures showed the advisability of encouraging the vehicle business in its initial stages.

Mr. W. A. A. Burgess suggested the advisability of standardising electric trucks with a view to cheapening construction. The vehicle battery voltage should be chosen at approximately half supply voltage, and twin cells could be used, charged in series and discharged in parallel. He thought there might be a saving by using tappings from the battery for starting. The suspension of the motor was important, as the unsprung weight affected tire wear.

Mr. W. E. Burnand referred to his own experience of a petrol and an electrical vehicle, and mentioned that the latter usually got the work to do, not because of its less costly operation, but because anyone could drive it. With the battery vehicle, the battery discharge rate was generally too high in non-electrical hands, and its maintenance was likely to be high; but there were undoubtedly possibilities for it. Regeneration was quite feasible, and his own experiments had shown that it was possible to return 30 per cent. of the energy on a trial run.

Mr. E. S. Shrapnell-Smith said it was probable that the electric car would pass through the financial troubles which had beset the petrol and steam-driven vehicles in their initial stages, but it would mark out its own sphere of work. It was a point that the electric car was silent on all speeds, while the petrol car at its best was noisy on low speeds. It was scarcely likely that the electric vehicle business would make money at the start; the working cost was the great factor in the sale of a vehicle, and such matters as

Fig. 2.—One-Ton Argo Electric Truck, with Linemen, &c., Melbourne Electricity Department.

battery car compared very well with petrol and steam-driven cars. The whole question of electric vehicle use was bound up with first cost, but he thought there was scope for municipal authorities to introduce it for their own use.

Mr. A. B. Pescatore said it was necessary to satisfy the public that the electric battery vehicle was cheaper to run than a petrol vehicle. The petrol chassis had a useful life of five years, and the noise or design were secondary. He had never been able to find out what the operating cost of the electric vehicle really amounted to.

This concluded the discussion; we have, however, received a letter from Mr. H. H. Harper, city electrical engineer, Melbourne, Australia, bearing on the use of battery vehicles by the Melbourne electricity supply department, which is of some interest in this connection, and is given herewith;—

"As a result of a trip through the United States between two and three years ago, I was very impressed with the possibilities in regard to the use of electric vehicles for transportation uses in the streets of a city. The vehicles shown in the photographs were purchased as a result of my inquiries in the States. All four vehicles are fitted with the Edison storage battery, of which, for transportation purposes, I have formed a very high opinion. They are of American make, the first one on the left (fig. 3) being the 'Argo' roadster capable of carrying four persons. With this vehicle we find it quite easy to maintain a speed of 25 miles an hour on the level, and the battery has sufficient capacity to run the car for about 60 to 70 miles on one charge.

"The next car shown is a 1-ton 'Argo' lorry or truck, as they are termed in America. This is fitted with an A6 size battery, as against the A4 size for the roadster. This vehicle is shown in a separate photograph (fig. 2) loaded with employés and linesmen, and drawing two linesmen's trucks. This vehicle is particularly useful in shifting men from place to place in the city, and for conveying materials and tools. It is capable of a speed of about 15 miles an hour on the level.

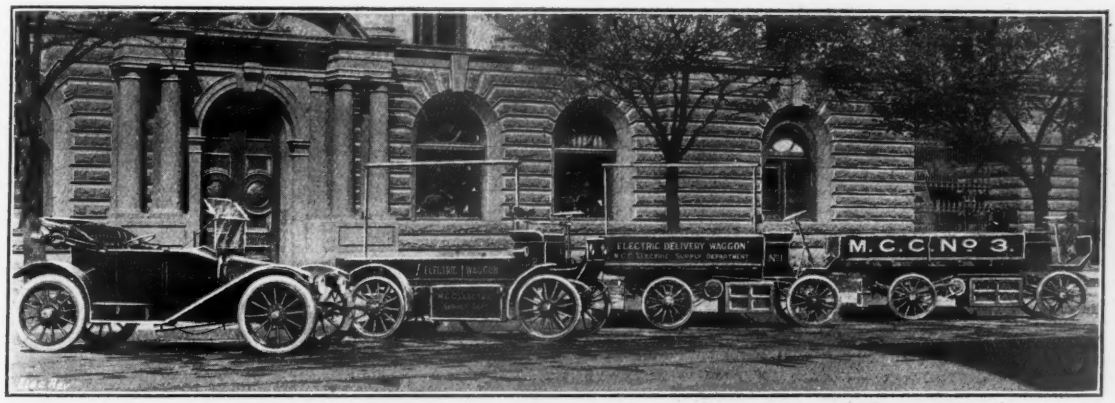


Fig. 3.—Group of Electric Vehicles used by the Melbourne City Council, Australia.

"The next two cars shown are of the well-known 'Baker' make, one being of ½ ton capacity (see also fig. 1), and the other, which is used by the city surveyor, of 1 ton capacity.

"The most striking feature in regard to the electric vehicle is the low cost of operation. Our records show that the roadster consumes about '25 of a unit per car-mile, while the wagons consume about from '54 to '67 of a unit per car-mile. On a daily run of, say, 30 miles, and allowing a charge of ½d. per unit for current, which is a good covering price, as the accumulators are charged after midnight, the cost of current for the roadster is under 4d. per day, and for the wagons from 8d. to 10d. per day.

"I expect that the near future will see a considerable increase in the number of electric vehicles operated by the City Council as a result of our experience with the four cars shown."

THE SHANGHAI ELECTRIC SUPPLY PROPOSAL.

The report of the Committee, which has been under consideration by the Municipal Council at Shanghai, and is referred to in our leader pages to-day, states that the Committee accepts in principle the following postulates:—

"1. The Council should hold not less than half the total number of shares in order to control all meetings of the company.

"2. The present security against the electricity loans should not be weakened.

"3. The liability for the repayment of the electricity loans should be duly provided for.

"In addition to these safeguards, it would be necessary to make stipulations with regard to the tariff of charges, including that for public lighting, and to ensure that any advance in rates shall receive the Council's sanction. It should also be agreed that the present policy of inviting tenders for machinery, supplies, wiring and accessories, shall be perpetuated.

"The franchise to be held by the company would, in these circumstances, not require a time limit.

"The Committee records the view that the departmental balance-sheet is as accurate a statement of the assets and liabilities of the department as can be compiled, and that therefore it would form a reliable basis upon which to work.

"The conversion, so far as it is a cash transaction, may be facilitated by providing for investment in instalments during a period of two years or more, as funds may be required.

"The present Electricity Committee may be requested to act as provisional directors during the conversion.

"As regards the capital of the company, the Committee inclines to the figure Taels 6 millions, on the grounds that it would be unwise to hamper the directors of the company as to the manner in which they may desire to raise additional capital in the future. Thus, even with a reserve of unissued capital of Taels 2 millions, the board may elect to issue debentures.

"It would be advisable that a moderate capital sum should be inserted as the value of the franchise, to be computed with due regard to the fact that it will bear dividend without possessing any earning power.

"The Committee considers that the capital should be divided into 120,000 shares of Taels 50 each, fully paid up, and that the articles of association should contain provision for increasing the total if necessary.

"It is admitted that the scheme will for the first few years weaken the Council's security against the electricity loans. The Committee, however, regards such weakening as not material, and in recommending the adoption of the scheme, the Committee records the view that by investing in the shares of the proposed company the Council would be doing no more than protect the ratepayers' interests, while, if the project is carried to a conclusion, the general status of municipal debentures will be strengthened by the fact that the sinking fund appropriation will be calculable upon the whole issue of debentures.

"The Committee does not consider that it is within the scope of its present inquiry to lay down an exact basis of conversion, which will be a matter for the Council's consideration, upon the scheme meeting with the approval of the ratepayers; but the Committee is prepared to furnish an outline of its proposal as soon as the statement of accounts of the department to December 31st is published."

In the course of a separate report Mr. T. H. U. Aldridge, the municipal electrical engineer, shows that the Council in converting the department would be relieved of a heavy responsibility, and would benefit financially. In regard to the cardinal question: "What advantage would accrue to the community by making the suggested change?" he gives the following answer:—

"1. That the Council would be relieved of the recurring necessity of raising large sums of money for extensions.

"2. That instead of receiving the small sum of Taels 26,000 per annum, it would receive an assured 8 per cent. on the capital invested in the co-operative company, bringing in some Taels 60,000 net profit on Taels 3,000,000 invested, that is 2 per cent. over and above the 6 per cent. at which the money was originally borrowed. In the likely event of more than 8 per cent. dividend being paid, so the return to the Council on its invested capital would be larger. Assuming a 10 per cent. dividend, the net annual profit to the Council would amount to Taels 120,000.

"What would be the position of the consumer of electricity?

"1. He would, by the greater outlets and possibilities of an expanded supply undertaking stand to obtain reduced rates of electricity.

"2. Electrical supplies would be obtainable at cheaper prices because the company's policy would be to sell fittings and accessories at lowest possible cost—not to make large profits thereon—in order to encourage the use of electricity to the utmost.

"3. The predominating share and influence of the Council's representation on the board would safeguard the consumer against the possibilities of the company becoming monopolistic and raising prices.

"There is also the investing public. This section of the community would be provided with an outlet for practically a secure safe investment, and would, as the undertaking expanded, have frequent opportunity for further investment.

"The need of some such system of co-operative dual control of electricity supply is being felt in both Europe and the United States. What cannot be too emphatically expressed is that the suggested scheme is not to hand over the electricity department to a purely private company which would have entire control and do as it pleased. Such a transfer would be disastrous and have nothing to commend it, but I submit that handing over the responsibility for the management and general control to a company, formed on the lines proposed, would achieve results which cannot be obtained whilst the undertaking is purely municipal, or, which could not be obtained if it were sold outright to a private company without the assistance of municipal finance. The advantage of the dual control is manifestly to give greater flexibility and opportunity to the concern whilst the municipal connection would, by enabling the company to obtain money more cheaply, provide greater facilities for lowering the cost of electricity. At the same time the Council would reap large contributions to the common good as represented by its holding of shares."

NEW PATENTS APPLIED FOR, 1914.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford, to whom all inquiries should be addressed.

5,890. "Devices for intermittently making and breaking electric circuits." R. G. Fyson. March 9th.

5,893. "Bar photometer." W. B. Ferguson and F. F. Renwick. March 9th.

5,894. "Electric switches." B. Thomas and E. Thomas. March 9th.

5,931. "Manufacture of armour-plate." S. O. Cowper-Coles. March 9th.

5,932. "Manufacture of metallic reflectors," S. O. Cowper-Coles. March 9th.

5,944. "Telegraph relay systems." A. Orling and Orling's Telegraph Instrument Syndicate, Ltd. March 9th.

5,966. "Device for the electrical control from a distance or other mechanisms, by means of a source of continuous currents." E. Schneider. March 9th. (Complete).

5,978. "Electric time-limit apparatus." British Thomson-Houston Co., Ltd., and E. B. Wedmore. March 9th.

5,991. "Means for telephonic and telegraphic communication with mine cages." J. H. Reineke. March 9th. (Addition to 19,102/12). (Complete).

6,008. "Railway locomotive controller." H. Hewitt, T. Gorst, and J. Smellie. March 10th.

6,013. "Shock-proof and fool-proof lampholder for electric lamps." L. S. Heaven. March 10th.

6,024. "Electric-light ball-joint bracket, with compression-plates." A. E. Green. March 10th.

6,037. "Electric filament lamps." E. Vass, L. Mateh, and F. Burger. March 10th. (Complete).

6,050. "Incandescent electric lamps." R. W. Birkett and J. H. Weiss. March 10th. (Complete).

6,054. "Electric smelting-furnaces." Fried. Krupp Akt.-Ges. March 10th. (Convention date, December 13th, 1913, Germany). (Complete).

6,055. "Electrodes." Fried. Krupp Akt.-Ges. March 10th. (Convention date, April 15th, 1913, Germany). (Complete).

6,066. "Apparatus for the electrical starting of petrol engines and the like." H. E. Donnithorne. March 10th.

6,070. "Electric switches or circuit-breakers." F. B. Holt. March 10th.

6,074. "System of selective electrical distribution." C. F. Kettering and W. A. Chryst. March 10th. (Divided Application on 7,545/13, March 31st. Convention date, November 20th, 1912, United States). (Complete).

6,088. "Power-generating plant." British Thomson-Houston Co., Ltd. (General Electric Co., United States).

6,093. "Electric baths." H. Aub. March 10th. (Complete).

6,097. "Telephone systems." E. A. Graham and W. J. Richet. March 10th. (Complete).

6,102. "Thermopiles." J. Marschall. March 10th. (Complete).

6,104. "Arc-light carbons." H. Ayrton. March 10th. (Addition to 1,775/13). (Complete).

6,118. "Mercury-joint packing for vacuum vessels." Quarzlampen G.m.b.H. March 10th. (Convention date, April 2nd, 1913, Germany). (Complete).

6,122. "Fuses or cut-outs for electric circuits." V. Hope. March 11th.

6,162. "Sequence switches." Western Electric Co., Ltd. (Franklin Tuthill Woodward, Belgium). March 11th.

6,173. "Electric-light reflectors." G. F. Allom. March 11th.

6,180. "Switch apparatus for use in connection with the electric lighting and heating equipments of railway and other vehicles." Electric & Ordnance Accessories Co., Ltd. & J. Etchells. March 11th. (Complete).

6,182. "Electric current collectors." T. B. G. Janssen. March 11th. (Complete).

6,199. "Generation of electrical power and methods of application of squirrel cage and asynchronous-synchronous electric motors and rotary converter systems, for power transmission and speed regulation, in electrical propulsion of ships, railway, tramway, road, aeronautical, agricultural, military, submarines, locomotive, trains, or similar self-contained or other vehicles, industrial machinery and the like." W. P. Durtnall. March 11th.

6,209. "Electrical impulse-transmitters and the like." Betulander Automatic Telephone Co., Ltd. & W. Aitken. March 11th.

6,210. "Automatic or semi-automatic telephone exchange systems." Gotthilf Ansgarius Betulander. March 11th. (Addition to 29,615/13. Convention date, May 24th, 1913, Sweden). (Complete).

6,214. "Means for electrical transmission and distant control of movements specially applicable to systems for signalling orders and the like." E. A. Graham & W. J. Rickets. March 11th. (Complete).

6,229. "Electroscopes and other electrostatic apparatus." G. B. Burnside and Glasgow Scientific Instrument Co. March 12th. (Complete).

6,285. "Dynamo-electric machines for use in lighting road vehicles and for starting the motors thereof." Carleon Electrical Co., Ltd. and G. Inrig. March 12th.

6,293. "Means for fixing electrical switches in wall boxes and the like." E. Brooks (trading as Walsall Hardware Mfg. Co.) & A. E. Read. March 12th.

6,319. "Photometers." J. M. G. Trezise. March 12th, 1913.

6,341. "Electricity meters." Siemens-Schuckertwerke G.m.b.H. March 12th. (Convention date, March 12th, 1913, Germany). (Complete).

6,350. "Arc lamps." W. E. Gray and W. Best. March 12th.

6,351. "Control of electric winding-gear." British Thomson-Houston Co., Ltd. & E. I. David. March 12th.

6,352. "Vapour electric devices." E. Weintraub. March 12th. (Convention date, March 13th, 1913, United States). (Complete).

6,353. "Vapour electric devices." E. Weintraub. March 12th. (Convention date, March 13th, 1913, United States). (Complete).

6,356. "Telephonic systems." E. A. Graham, W. J. Rickets and E. A. Sanftleben. March 12th. (Complete).

6,379. "Device for heating air electrically to assist in starting automatic lighting-plant driven by internal-combustion engine." R. A. Lister & Co., Ltd., and D. J. Suffield. March 13th.

6,389. "Automatic telegraphic or radio-telegraphic transmitters." E. Belin. March 13th. (Complete).

6,390. "Electrical solenoids or electro-magnets." S. Whipp, C. W. F. Bourne, and F. Whipp. March 13th. (Complete).

6,398. "Resistance body." E. C. R. Marks. March 13th. (Geb. Siemens and Co., Germany). (Complete).

6,403. "Metallic fittings for electric continuity system." F. J. B. Wineberg. March 13th.

6,418. "Electric condenser." Allgemeine Elektricitats-Ges. March 13th. (Convention date, March 13th, 1913, Germany). (Complete).

6,421. "Means or apparatus for indicating when the flow of current in an electric circuit is interrupted or varied." A. F. Berry. March 13th.

6,424. "Electrically-operated steering-gear and analogous apparatus." W. H. Scott. March 13th.

6,425. "Electro-magnetic switches." G. Paris. March 13th. (Convention date, March 19th, 1913, France). (Complete).

6,428. "Telephone systems." Automatic Telephone Mfg. Co., Ltd. March 13th. (Automatic Electric Co., United States). (Complete).

6,430. "Combined electric starting and lighting arrangement, more particularly for use on motor-cars and the like." A. H. Midgley and C. A. Vandervell. March 13th.

6,439. "Filaments for incandescent electric lamps and methods of making the same." British Thomson-Houston Co., Ltd. (General Electric Co., United States). March 13th.

6,440. "Device serving as electric current indicator, current-strength indicator, and installation protector." British Thomson-Houston Co., Ltd. (Allgemeine Elektricitats-Ges, Germany). March 13th.

6,458. "Electrical apparatus for the detection of icebergs and the like for ships at sea." E. Lawton. March 14th.

6,492. "Electric current distribution means and collecting-apparatus therefor." G. Cope. March 14th.

6,520. "Means for electrically operating railway or other signals." Siemens Bros. & Co., Ltd., and L. de M. G. Ferreira. March 14th.

PUBLISHED SPECIFICATIONS.

Copies of any of the Specifications in the following list may be obtained of Messrs. W. P. Thompson & Co., 285, High Holborn, W.C., and at Liverpool and Bradford; price, post free, 9d. (in stamps).

1912.

21,485. Illuminating Devices. British Thomson-Houston Co. and H. S. Wheat. March 19th. (March 19th, 1913).

26,781. Sound Reproducing and Transmitting Apparatus. W. H. Derriman. (Automatic Enunciator Co.). November 21st.

26,782. Telephone Systems. W. H. Derriman. (Automatic Enunciator Co.). November 21st.

1913.

1,599. Electric Switches. British Thomson-Houston Co. and H. C. Heath. January 20th.

1,775. Arc-light Carbons. H. Ayrton. January 22nd.

1,927. Automatic Electric Switch. H. F. Bigge and F. R. Butt. January 23rd. (July 10th, 1913).

4,499. Telephone Systems. Automatic Telephone Manufacturing Co. (Automatic Electric Co.). February 21st.

4,507. Starting Switches and the like for Alternating Current Induction Motors. Siemens Brothers Dynamo Works, Ltd. and C. Rogers. February 21st.

4,508. Electric Ignition Systems for Internal Combustion Engines. C. F. Kettering. February 21st. (March 4th, 1912).

4,584. Selective Electric Signalling. H. H. Harrison and C. M. Jacobs. February 22nd.

4,931. Section Insulators for Overhead Conductors. J. Ramsey and A. W. Maley. February 26th.

5,086. Advertising Appliances. J. Farley. February 28th. (Addition to 9,561/10).

5,763. Method of Electrically Governing the Speed of Engines at Sea. A. W. Fithian. March 8th.

7,382. Electric Insulators. F. Browalski. March 28th. (March 30th, 1912).

7,885. Apparatus for the Display of Announcements. Advertisements and the like. A. E. Turnham. April 3rd. (Cognate Applications, 9,980/13 and 19,110/13).

7,918. Enclosed Electric Switches. V. Hope. April 4th.

8,445. Means for Connecting Lamp Holders to Bracket or Pendant Tubes or like Wire Conduits. G. St. J. Day. April 10th.

9,592. Electric Contacts and Switching or Contacting Apparatus. Soc. Anon. les Etablissements L. Bleriot. April 23rd. (April 24th, 1912.)

9,624. Transmission Systems for Electric Telegraphs and the like. W. P. Thomson. (Soc. Anon. des Telegraphes Edouard Belin). April 24th.

12,238. Extensible Electric-light Fixtures. F. Garrecht. May 26th.

12,437. Means for Electrically Indicating or Counting Revolutions of Shafts, Axles, or the like. Siemens Bros. & Co., and F. Hird. May 28th.

12,956. Multipole Ignition Magneto with Rotary Field Magnet. Neufeult and Kuhnke (Firm of). June 4th. (January 13th, 1913).

13,610. Cooling of Apparatus Built in Connection with an Electric Motor. Akt. Ges. Brown, Boveri et Cie. June 12th. (February 20th, 1913).

14,188. Electrical Switches. A. P. Lundberg, G. C. Lundberg, P. A. Lundberg, and G. Pegg. June 19th.

14,380. Windings for Dynamo Electric Machinery. Siemens Bros. Dynamo Works, Ltd. (Siemens Schuckertwerke Ges.). June 21st.

14,426. Magnetic Separators. Fried Krupp Akt. Ges. Grusonwerk. June 21st. (July 19th 1912).

14,459. Operating Mechanism of Sand Discharge Valves for Electrically-propelled Vehicles. J. F. Simpson. June 23rd.

15,060. Reverting Relay Devices for Use in Connection with Electric Circuits. Maschinenfabrik Oerlikon. June 30th. (March 7th, 1913).

15,259. Electric Alarm for Preventing the Unauthorised Opening of Locks. O. Schumann. July 2nd. (August 5th, 1912).

15,284. Charging and Discharging of Electrical Condensers or the like. W. J. Mellersh-Jackson (Signal Ges). July 2nd.

15,686. Variable Speed Dynamo-electric Machines. B. Brooks and W. Holt. July 8th.

16,428. Electro-motors for Portable Electric Drilling Machines and the like. G. F. D. Campbell. July 17th.

16,609. Means for Operating Electrical Switches. M. Drysdale and Displayer Co. July 19th.

16,705. Trolley Heads for Overhead Conductor Electric Traction Systems. E. H. Underwood. July 21st.

17,416. Electric Glow-lamps. Siemens & Halske Akt. Ges. July 29th. (August 2nd, 1912).

17,665. Electrically-heated Flat Irons. Siemens-Schuckertwerke Ges. August 1st. (August 6th, 1912).

17,918. Electric Imitation Candle Lamps. Candolite Co. and F. Taussig. August 6th.

19,517. Polyphase Alternating Current Commutator Motors. E. F. W. Alexanderson. August 28th. (August 28th, 1912).

19,592. Selector Switches for Telephone Systems. Sterling Telephone and Electric Co. (Telephonfabrik Akt. Ges.-vorm J. Berliner). August 29th.

20,796. Recording Galvanometers. Paul Braun & Co. September 15th. (September 14th, 1912).

21,891. Marine Cableways. T. S. Miller. September 29th.

22,744. Process for the Electrolytic Deposition of Metals from Solutions Containing Same. N. V. Hybinette. October 8th.

22,745. Electrolytic Process for Extracting Copper from Ores. October 8th. N. V. Hybinette.